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West Fork of Swift Creek Timber Sale Project

Final Environmental Impact Statement

Resource Appendices

January 2005

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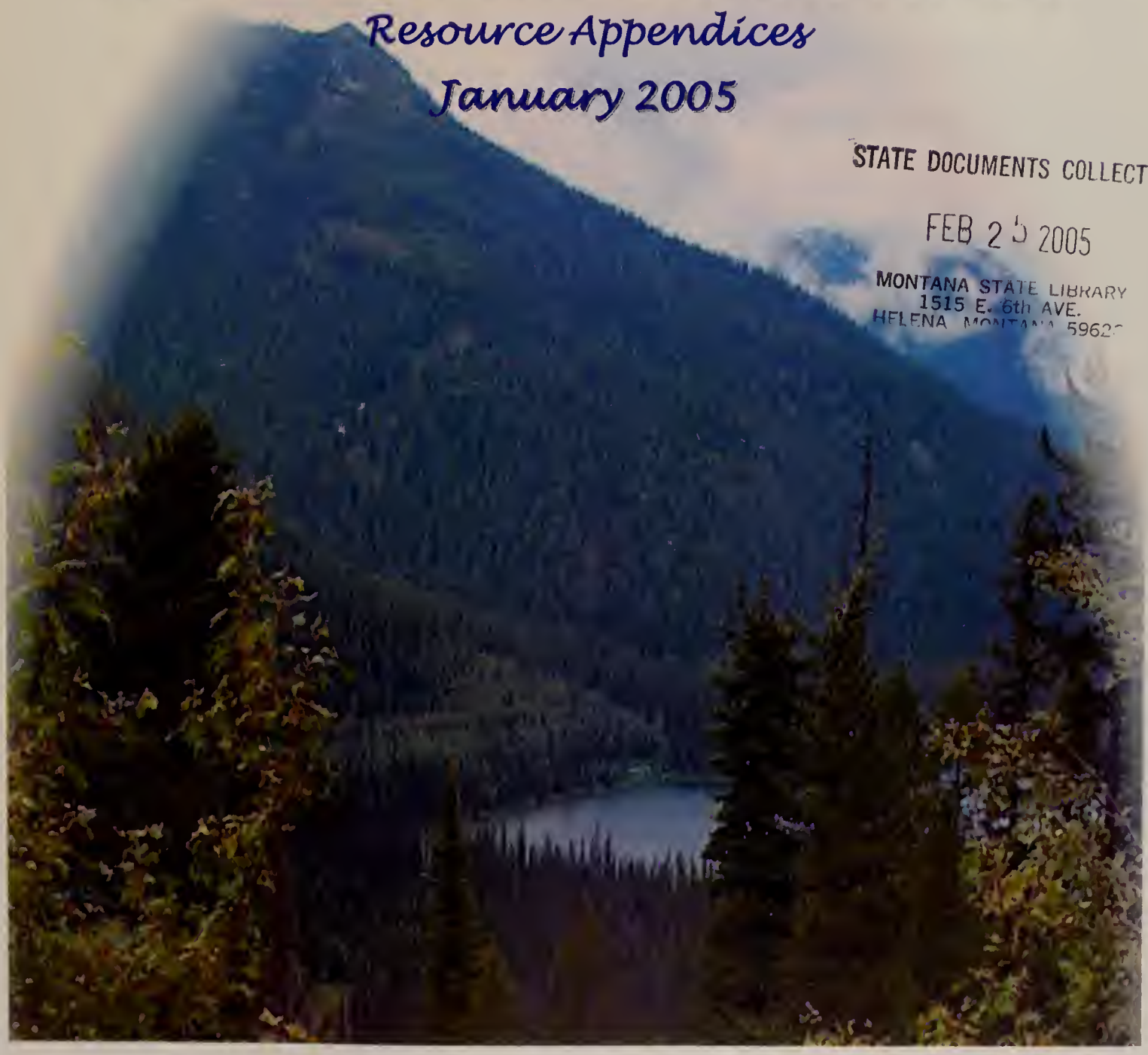

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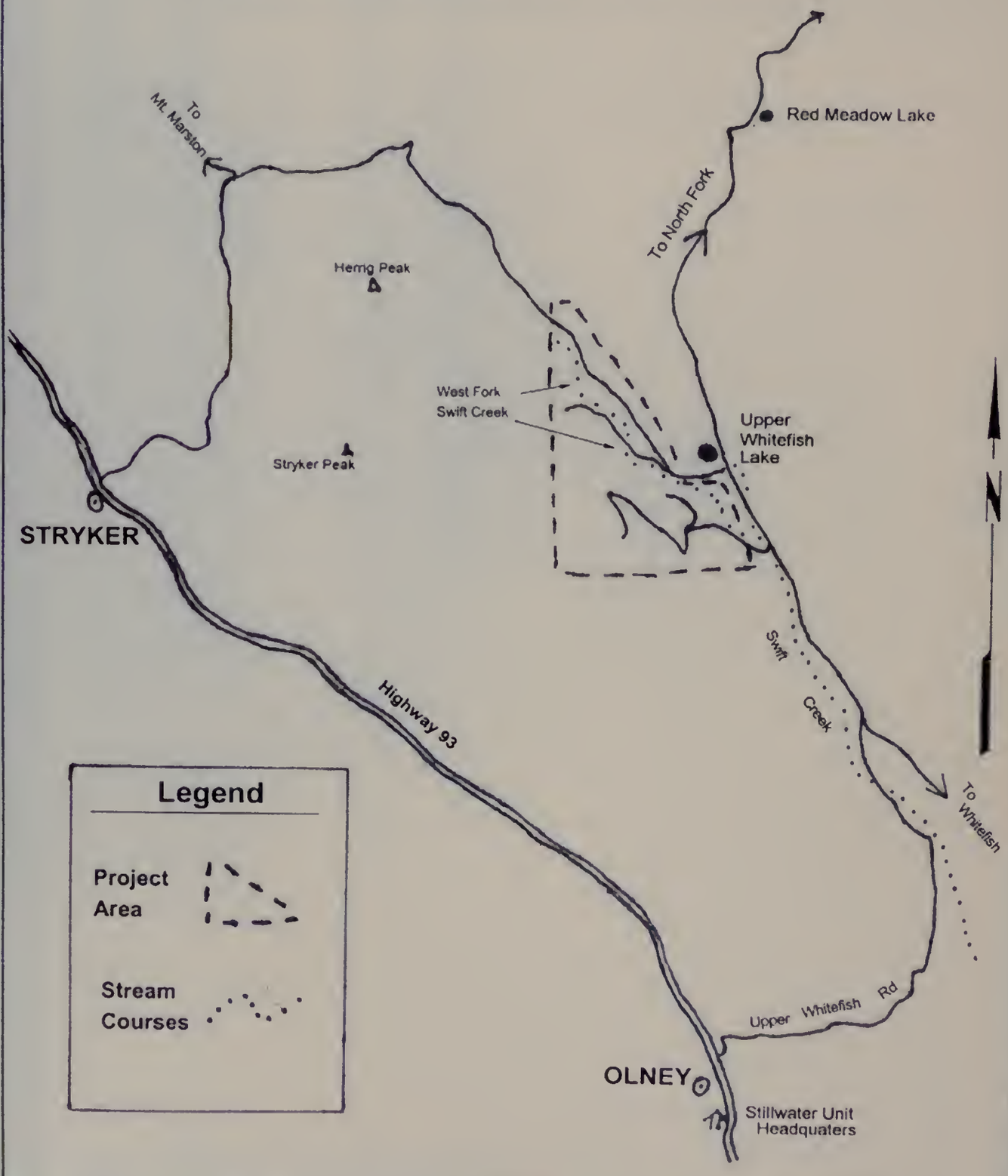
Vicinity Map for the West Fork Timber Sale Proposal



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Appendix A

Stipulations and Specifications

APPENDIX A
STIPULATIONS AND SPECIFICATIONS

Stipulations and specifications for the action alternatives were identified or designed to prevent or reduce potential effects to resources considered in this analysis. In part, stipulations and specifications are a direct result of issue identification and resource concerns. This section is organized by resource.

Stipulations and specifications that apply to operations required by and occurring during the contract period would be contained within the timber sale contract; as such, they are binding and enforceable. Stipulations and specifications relating to activities that may occur during or after the contract period (hazard reduction, site preparation, planting) would be enforced by project administrators.

The following stipulations and specifications are incorporated to mitigate effects on resources involved with action alternatives considered in this proposal.

WATERSHED AND FISHERIES

- Planned erosion-control measures and BMPs include:
  - installing grade breaks on roads,
  - installing water-diverting mechanisms on roads,
  - installing slash-filter windrows, and
  - grass seeding.

  Details for these control measures would be included in *APPENDIX B* of the *TIMBER SALE AGREEMENT*.
- SMZs and RMZs would be defined along those streams that are within or adjacent to timber-harvesting areas. Harvesting operations would be a minimum of 100 feet from the West Fork and Stryker Creek to protect areas adjacent to streams and maintain water quality.
- Culvert sizing for all road projects would be as recommended by the DNRC hydrologist for a 50-year flood period.
- Stream crossings, where culvert or bridge removals and installations are planned, would have the following requirements, as needed, to meet the intent of water-quality permits and BMPs and protect water quality:
  - Slash-filter windrows would be constructed on the base of the fill slopes.
  - Silt fences would be installed along the streambanks prior to and following excavation at crossing sites.
  - Filter-fabric fences would be in place downstream prior to and during culvert installation.
  - Bridge work within the stream area of the West Fork stream crossing would be limited to the period of July 15 through August 20 in order to avoid the bull trout spawning period.
- Water-quality monitoring would continue in the Swift Creek and Fitzsimmons drainages to assess and track water quality and resource values associated with water quality. In addition, the monitoring would provide data for water-quality studies being conducted in the Flathead Basin.
- Brush would be removed from existing road prisms to allow effective maintenance. Improved road maintenance would reduce sediment delivery.

- The contractor would be responsible for the immediate cleanup of any spills (fuel, oil, dirt, etc.) that may affect water quality.
- Leaking equipment would not be permitted to operate in stream-crossing construction sites.
- Included in the project proposal are the following pertinent recommendations of the *Flathead Basin Forest Practices, Water Quality, Fisheries Cooperative Program Final Report (June 1991)*.
- The following numbers correspond to the numbering of recommendation items contained within the aforementioned document, included in pages 154 through 162 of the final report:

1. BMPs are incorporated into the project design and operations of the proposed project.
2. Riparian indicators would be considered in the harvest unit layout.
3. Management standards of the SMZ Law (*75-5-301 MCA*) are used in conjunction with the recommendations of the study.
4. The BMP audit process will continue. This sale would likely be reviewed in an internal audit and may be picked at random as a State-wide audit site.
7. SMZs will be evaluated as a part of the audit process.
11. Swift Creek monitoring is part of the Flathead Basin monitoring effort.
12. Watershed-level planning and analysis are complete. Logging plans of Plum Creek Timber Company, USFS, and Stoltze Land and Lumber Company, as reported to the Cumulative Watershed Effects Cooperative, are used.
14. DNRC is cooperating with DFWP on a further study of the fish habitat and population for Swift Creek and its tributaries.
15. DNRC would use the best methods available for logging and road building for this proposal.

16A. Existing roads are fully utilized for this proposal.

17. DNRC requested inventory information from DFWP. DNRC's mitigation plan for roads fits all recommendations for "impaired streams". Using "worst-case scenario" criteria provides for conservative operations in this proposal.
18. Provisions in the Timber Sale Agreement address BMPs that are rigidly enforced.
20. Planning for long-term monitoring of Swift Creek is in place.

29-34. DNRC has cooperated with DFWP to continue fisheries work. DNRC will continue to monitor fisheries in the future as funding allows.

WILDLIFE

GRIZZLY BEARS

The following items are incorporated into this proposal:

- The grass seeding plans to revegetate roads include a combination of seed mixtures that have different palatability in relation to grizzly bears. The less palatable species are planned for areas where bear use is to be discouraged to minimize the potential for bear/human conflicts.
- No logging camps would be allowed in the sale area.
- Garbage hauling would be required daily.

- The Forest Officer would, if necessary, immediately suspend any or all activities directly related to the proposed action to prevent imminent confrontation or conflict between grizzly bears (or other threatened or endangered species) and humans.
- Vigorous patches of Vaccinium sp. (huckleberry) would be avoided during scarification when possible.
- Contractors would be prohibited from carrying firearms while working under contract.
- All gates would be closed after each entry during the general big game hunting season.
- Road management would vary by alternative and includes proposals given in *CHAPTER II - ALTERNATIVES*.
- A vegetative screen would be retained along open roads.

WOLVES

A contract provision would be included to protect any wolf den or rendezvous site within the gross sale area that may be discovered during implementation of this proposal.

CANADA LYNX

During site preparation, available cull logs would be piled to provide future habitat.

SNAG RETENTION

- Wildlife trees of high quality, such as large broken-topped western larch, would be designated for retention and given special consideration during yarding operations to prevent loss.
- Snag retention and recruitment: All cull snags that are safe to operate near and a minimum of 1 to 2 of the larger trees per acre, preferably greater than 21 inches dbh, would be retained. The number of trees and snags larger than 21 inches dbh is dependent on habitat group.

BALD EAGLE

- Timing restrictions would be implemented on the Whitefish Saddle Road; log hauling is restricted to August 15 through February 1.
- Timing restrictions would be implemented for logging operations in Harvest Area II-A, with logging restricted to the period between August 15 through February 1.

ROADS

- Road reconstruction activities and road use associated with road construction activities would be relayed to the general public.
- BMPs would be incorporated in all planned road construction.

AESTHETICS

- Damaged residual vegetation would be slashed.
- Landings would be limited in size and number and located away from main roads when possible.
- Disturbed sites along road rights-of-way would be grass seeded.

AIR QUALITY

The first item is designed to prevent individual or cumulative effects during burning operations. The next 3 items are designed to reduce effects from burning operations.

- Burning operations would be in compliance with the Montana Airshed Group reporting regulations and any burning restrictions imposed in Airshed 2. This would provide for burning during acceptable ventilation and dispersion conditions.
- Excavator, landing, and roadwork debris would be piled clean to allow ignition to occur during fall and spring when ventilation is good and surrounding fuels are wet. The Forest Officer may

require that piles be covered to reduce dispersed (unentrained) smoke. Covered piles are drier, ignite easier, burn hotter, and extinguish sooner.

- In order to reduce smoke production, the number of burn piles would be minimized by leaving large woody debris on site.
- Dust abatement may be applied on some of the segments of Upper Whitefish Road that would be used during hauling; whether dust abatement would be applied depends on the season of harvest and level of public traffic.

SOILS

COMPACTION

- Logging equipment would not operate off forest roads unless:
  - soil moisture is less than 20 percent,
  - soil is frozen to a depth that would support machine operations, or
  - soil is snow covered to a depth that would prevent compaction, rutting, or displacement.
- Existing skid trails and landings would be used where their design is consistent with prescribed treatments and meets current BMP guidelines.
- Designated skid trails would be required where moist soils or short steep pitches (less than 300 feet) would not be accessed by other logging systems. This would reduce the number of skid trails and the potential for erosion.
- Skid-trail density in a harvest area would not exceed 20 percent of the total area in a cutting unit.

SOIL DISPLACEMENT

- Conventional ground-based skidding equipment would not be operated on sustained steep slopes (greater than 40 percent). Soft-tracked yarders are suitable on slopes up to 55 percent with less impact than conventional tractor skidding. Cable yarding would be used on sustained steeper slopes.
- Piling and scarification would be completed with a dozer where slopes are gentle enough to permit. Steeper slopes would have slash treatment and site preparation done by using an excavator or broadcast burning.

EROSION

- Ground skidding machinery would be required to be equipped with a winchline to limit equipment operation on steeper slopes.
- Roads used by the purchaser would be reshaped and the ditches redefined prior to and following use to reduce surface erosion.
- Drain dips, open-topped culverts, and gravel would be installed on roads as needed to improve road drainage and reduce maintenance needs and erosion.
- Some road sections would be repaired to upgrade the roads to design standards that reduce erosion potential and maintenance needs.
- The prompt and timely application of certified weed-free grass seed and fertilizer would be applied to newly constructed road surfaces and cut-and-fill slopes. These applications would also be applied to any existing disturbed cut-and-fill slopes and landings immediately adjacent to open roads. These would be done to stabilize soils and reduce or prevent noxious weed establishment and would include:
  - seeding all road cuts and fills concurrent with construction,
  - applying "quick-cover" seed mix within 1 day of work completion at culvert installation sites, and
  - seeding all road surfaces and reseeding culvert installation

sites when the final blading is completed for each specified road segment.

- Water bars, logging-slash barriers, and, in some cases, temporary culverts would be installed on skid trails where erosion is anticipated, based on ground and weather conditions and as directed by the forest officer. These erosion-control features would be periodically inspected and maintained throughout the contract period or extensions thereof.

NOXIOUS WEED MANAGEMENT

- Surface blading on roads affected by the proposal may be required to remove weeds before the seed-set stage.
- All tracked and wheeled equipment would be cleaned of noxious weeds prior to beginning project operations. The contract administrating officer would inspect equipment periodically during project implementation.
- Prompt revegetation of disturbed roadside sites would be required.
- Roads used and closed as part of this proposal would be reshaped and grass seeded.

ARCHAEOLOGY

A review of the project was conducted by a DNRC archaeologist. A contract clause provides for suspending operations if cultural resources were discovered and operations would only resume as directed by the Forest Officer.

Appendix B
Vegetation Analysis

APPENDIX B
VEGETATION ANALYSIS

INTRODUCTION

This section will provide a description of the present vegetative conditions of the forest and address the potential effects of the proposed alternatives related to the following issues:

- Covertype and age-class distributions through a landscape-level analysis of timber stands.
- Old-growth-stand distribution at a landscape level and old-growth-stand attributes.
- Stand development in relation to natural disturbances and management activities.

ANALYSIS METHOD

The SFLM Rules direct DNRC to take a landscape-level or coarse-filter approach to biodiversity. To promote biodiversity, an appropriate mix of stand structures and compositions on State land should be favored (*Montana DNRC 1996*). To implement a coarse-filter approach, landscape analysis techniques were used to determine an appropriate mix of stand structures and compositions based on ecological characteristics, such as landtypes, climatic sections, habitat types, disturbance regimes, and other unique characteristics, on Stillwater State Forest. Covertype representations and age-class distributions are general characteristics shown in the landscape-level analysis.

This analysis will compare the desired stand conditions that DNRC believes to be appropriate for the site with current stand conditions. A forest inventory from the 1930s was used in *Losensky's 1993* data to estimate the proportion of various stand-structure stages by covertype and age class as they were historically represented throughout the Inland Northwest. This provides an estimate of the natural characteristics of forests prior to fire suppression and extensive logging. *Losensky (1997)* worked with DNRC to complete an analysis for the entire State; some vegetation types specific to that work are included in this analysis.

The protocol used to assign covertypes on DNRC forested lands, including Stillwater Unit, is explained in detail in the SFLM Rules (*ARM 36.11.405*). The SLI database used for this analysis is the September 15, 2003 version of "main block and scattered north.dbf" (*STW 2003 SLI data*). This data is available at the Stillwater Unit office at Olney. The methodology used to analyze current and appropriate stand conditions follows:

Two filters were developed and applied to Stillwater State Forest's SLI data (*STW 2003 SLI*). The filters were assigned covertypes similar to those used in the inventory of the 1930s. The first filter followed the 1930s criteria exactly, or as closely as possible, representing current conditions. The other filter for appropriate conditions assigns covertypes using criteria primarily designed to help address the situation where succession from one covertype to another was occurring. The successional filter was developed to indicate that those areas in the absence of fire suppression, introduced pathogens, and timber harvesting would likely have been assigned to a different covertype than the current covertype filter would suggest. The appropriate filter then estimates, from the current condition of the stand, what the stand would have looked like in 1900.

The methods to identify old-growth timber stands are initiated from modeling based on the STW 2003 SLI data. The query primarily sorts for stands that meet the age criteria and number of trees greater than a certain dbh based on habitat-type groups; refer to the *GLOSSARY* for DNRC's old-growth definition. Field surveys were used to verify those modeled old-growth stands and determine if additional stands meet the definition within the project area.

The analysis on stand development will be a qualitative discussion of the conditions of timber stands, including how various natural and man-caused disturbances and site factors have affected, and may continue to affect, timber-stand development.

ANALYSIS AREA

The vegetation analysis includes 3 geographic scales:

- Upper Flathead Valley - Historic conditions refer to those from Climatic Section 333C of the Upper Flathead Valley (*Losensky 1997*). For this analysis, the historic conditions for Climatic Section 333C relate to forest covertypes and age-class distributions only.
- Stillwater State Forest management block - Current and appropriate conditions were analyzed on the scale of the entire Stillwater State Forest and scattered outlying sections in northeastern Lincoln County (approximately 100,208 forested acres). Current and appropriate conditions for covertype, age, and old-growth distribution were analyzed at this scale.
- Project level - Stand attributes related to old growth, species composition, and stand development will be analyzed by harvest area.

COVERTYPE

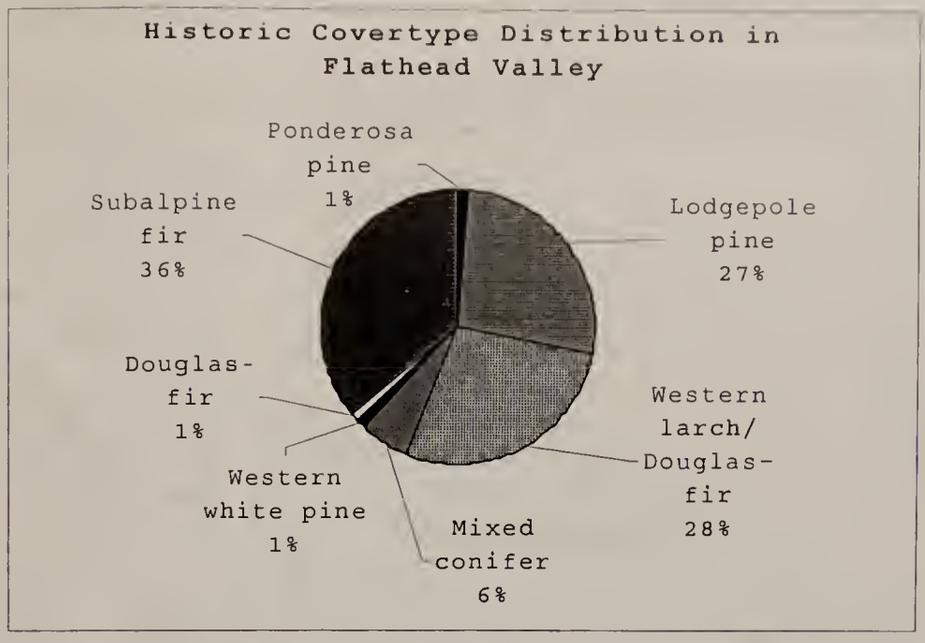
FIGURES B-1 through *B-3 - PERCENTAGE OF FORESTED ACRES BY COVERTYPE* illustrate the percentage of forested ground that is/was occupied by a particular covertype. The comparison shown includes the Upper Flathead Valley historic covertype data and current and appropriate covertype conditions on the scale of the analysis area (Stillwater Unit). The chart displaying historic conditions is from *Lozensky's* data and covers forested types of a much larger scale than do the current and appropriate conditions.

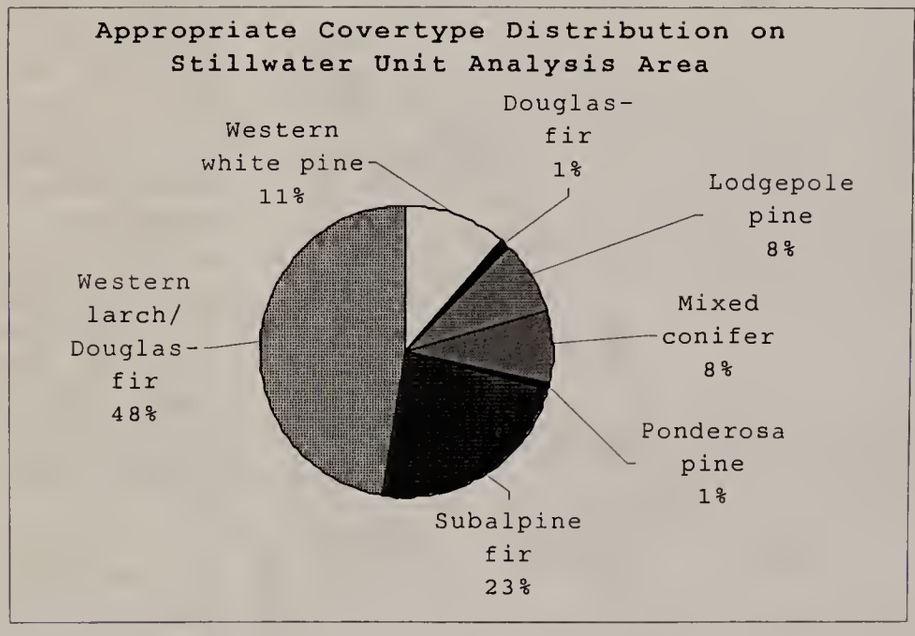
Data indicates, as illustrated by *FIGURES B-2 and B-3*, that mixed-conifer stands are currently overrepresented in reference to both historic conditions and conditions that DNRC feels appropriate by using historic data (desired future covertype conditions). Many of the species that make up the mixed-conifer covertype are shade tolerant and their representation increases as the intervals between disturbances, such as wildfires, lengthens.

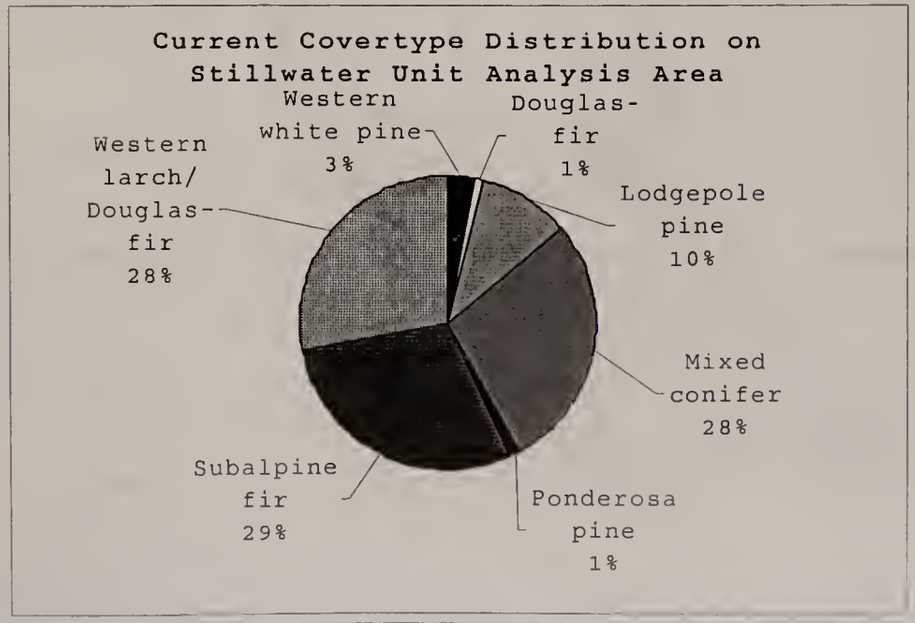
The western larch/Douglas-fir and lodgepole pine covertypes are currently underrepresented on the forest in reference to ***appropriate conditions***; western larch and lodgepole pine are not shade tolerant and, historically, the species have been perpetuated through fairly intensive disturbances, such as wildfires.

The data sort indicates the amount of western white pine covertype is slightly lower than what occurred historically. The white pine blister rust infection has drastically affected the western white pine. In reality, the number of healthy western white pine that occupy the canopy as overstory dominants has been on the decline across most of the Pacific Northwest for several decades.

FIGURES B-1 THROUGH B-3 - PERCENTAGE OF FORESTED ACRES BY COVERTYPE ON STILLWATER UNIT







AGE-CLASS DISTRIBUTION

Age-class distributions delineate another characteristic important for determining trends on a landscape level.

Inventories of the 1930s quantified the ages of the forest stands. To arrive at age estimates, *Losensky* examined the data and projected the stands back in time to the early 1900s. This data is useful in setting baseline conditions for determining the extent that current forest age-class distribution deviates from average historical conditions.

Comparing the entire Stillwater State Forest with historical data from the Upper Flathead Valley, *TABLE B-1 - DISTRIBUTION OF AGE CLASSES ON THE CONTIGUOUS STILLWATER STATE FOREST* shows that Stillwater State Forest is low in stands of the seedling-sapling age class and higher is stands that are in the 40-years-and-older age classes.

TABLE B-1 - DISTRIBUTION OF AGE CLASSES ON THE CONTIGUOUS STILLWATER STATE FOREST

AGE CLASS	HISTORIC PERCENT	CURRENT PERCENT
0 to 39 years	36	10
40 to 99 years	12	23
100 to 150 years	22	19
150+ years	29	48

OLD GROWTH

OLD-GROWTH DISTRIBUTION

Old growth, for this analysis, is defined as stands that meet the minimum criteria (number of trees per acre that have a minimum dbh and a minimum age) for a given site, ***which is based on habitat-type grouping.*** The criteria can be found in *Green et al (Old Growth Forest Types of the Northern Region).* Based on SLI data, field surveys within the project area, and the effects of other timber sales on SLI old-growth data, approximately 8,679 acres, or 8.7 percent, of the coarse-filter analysis area can be classified as old-growth. ***The amount of old growth present in the Stillwater analysis area is within an expected range of natural variation of old-growth levels based on previous DNRC analysis. Similar to the restrictive definition DNRC currently uses, the analysis using Option 2 was based on a narrower range of old-growth conditions emphasizing stands with higher old-growth attribute levels (DNRC 2000).*** No field-verified old growth or SLI potential old growth has been identified in the northern scattered sections; therefore, those areas are not displayed in *FIGURE B-4 - OLD-GROWTH ON MAIN BLOCK OF STILLWATER STATE FOREST.* .

TABLE B-2 - OLD-GROWTH ACRES BY COVERTYPE displays old growth by

TABLE B-2 - OLD-GROWTH ACRES BY COVERTYPE

CURRENT COVERTYPE	DOUGLAS-FIR	LODGEPOLE PINE	MIXED CONIFER	SUBALPINE FIR	WESTERN LARCH/ DOUGLAS-FIR	WESTERN WHITE PINE	TOTALS
Gross acres by SLI	44	398	1,802	3,139	2,432	481	8,296
Additional old growth confirmed by West Fork Project			183	200			383
Totals	44	398	1,985	3,339	2,432	481	8,679

FIGURE B-4

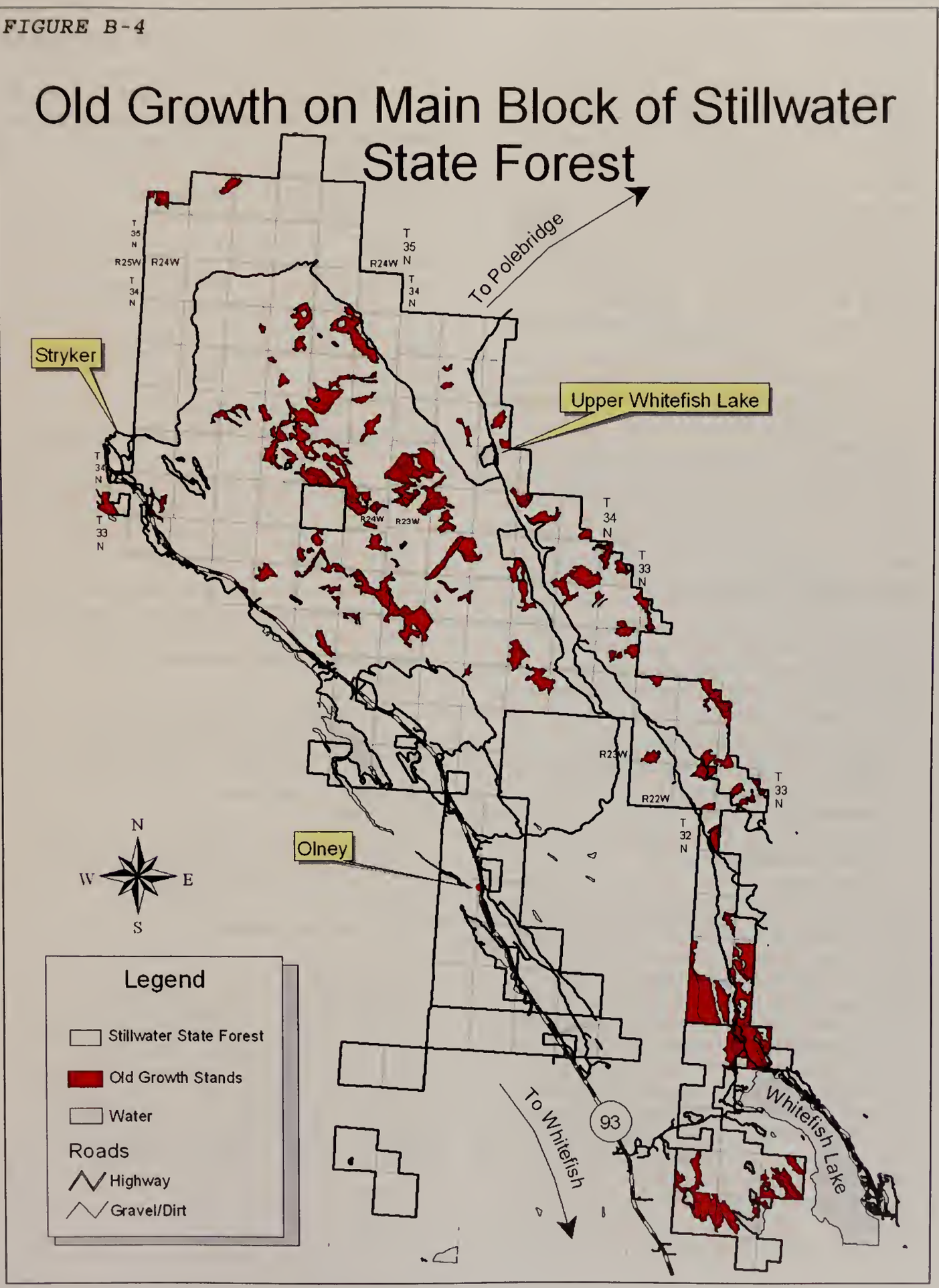

Old Growth on Main Block of Stillwater State Forest
To Polebridge
Stryker
Upper Whitefish Lake
Olney
To Whitefish
93
Whitefish Lake
T 35 N R25W
R24W
T 34 N
T 33 N
R23W
R22W
T 32 N
N
W
E
S
Legend
Stillwater State Forest
Old Growth Stands
Water
Roads
Highway
Gravel/Dirt

TABLE B-2 - OLD-GROWTH ACRES BY COVERTYPE displays old growth by forest covertype. Covertype is related to habitat type, habitat-type groups, and successional stages. Covertype is used when presenting old growth because the amount can be correlated to Lozensky's historic information. Subalpine fir and western larch/Douglas-fir (as displayed below in *TABLE B-2 — OLD-GROWTH ACRES BY COVERTYPE*) are the 2 dominant old-growth covertypes on Stillwater State Forest.

Old growth within the project area can be viewed in *FIGURE B-5 - WEST FORK OLD-GROWTH MAP* under *ALTERNATIVE EFFECTS (page B-12)*. In addition to old-growth stands identified by SLI in the project area, approximately 383 field-verified acres of old growth have been identified.

OLD-GROWTH ATTRIBUTES

DNRC is in the process of developing a tool to assign old-growth attribute levels to stands by sorting SLI data. The attributes considered are:

- number of large live trees,
- amount of coarse woody debris,
- number of snags,
- amount of decadence,
- multistoried structures,
- gross volume, and
- crown density.

This data sort assigns a value or an index rating to an old-growth stand that indicates its total score. These scores can be grouped into low, medium, and high categories. This provides an indication of the condition of the stand in reference to attributes that are often associated with old-growth timber stands. These attribute levels are not necessarily an indication of quality, but are tools to compare and classify a collection of older stands over the landscape. The expected variation of levels are based on numerous factors, including habitat groups, tree species, covertype, altitude, past management activities, and proximity to roads. Many of these attributes will relate to wildlife and be discussed within *APPENDIX E - WILDLIFE ANALYSIS*.

Within the project area, the attribute index ratings are primarily medium. The SLI category for most of the field-verified, old-growth stands was low, but based on data collected on these areas (number of larger diameter trees per acre and gross volume per acre), those stands should be within the medium attribute levels.

Some of the old-growth characteristics within the project area:

- Engelmann spruce and subalpine fir are the dominant tree species in all of the old-growth stands, which total 777 acres.
- Whitebark pine is a component of the overstory and snag attributes in 7 old-growth stands, which amounts to approximately 313 acres.
- The stand structures are all multistoried, with seedlings to large sawtimber-sized trees.
- Vigor is average to poor in all stands.
- Snag levels are generally high, with greater than 3 snags per acre.

STAND DEVELOPMENT

Natural processes of stand development and disturbance are influenced by environmental conditions and site characteristics, such as soils, stand covertype, forest health, elevation, and stand structure. The stand structures and species component can be greatly modified by natural disturbances, such as wildfire and blowdown

STAND COVERTYPE

Site factors, such as soil type, aspect, elevation, growing season, and moisture availability, are combined to develop habitat-type classifications, which are then used to describe successional development and timber productivity, among other things *(Pfister et al, 1977)*. For the project area, 95 percent of the acreage is categorized in the "cool and moist" habitat group, and 99 percent of the area is currently represented by the subalpine fir and mixed-conifer covertypes.

TIMBER-STAND HEALTH

Damage and mortality from insects and diseases are relatively minor in forest types that exist in this area. A rise has occurred in the incidence of western balsam bark beetles, mountain pine beetles, and white pine blister rust, as well as minor levels of infestations of spruce bark beetles, Douglas-fir beetles, and fir engravers. Indian paint fungus is common in subalpine fir throughout this area. In addition to the insects and pathogens listed above, trees throughout the project area have mechanical damage caused by previous logging, as well as damage caused by wind, snow, and ice, which has allowed rot to develop in the boles of the trees and value to be lost. Also, stands where tree crowns appear sparse and ratty reflect poor vigor and slow growth.

ELEVATION/ASPECT

The elevation of a stand has great importance in determining not only what tree and shrub species are present, but also how fast or slow changes take place. Elevations in the project area range from 4,300 feet to 6,500 feet above sea level. Based on measurements taken over the last 27 years, the average snow depth for the Herrig snow-course survey, which is located in Harvest Area II-P, is 65 inches. A large portion of the project area has a northeast aspect. This exposure, together with high elevations, account for the high moisture availability, as well as the long duration snow is on the ground. These 2 factors, elevation and aspect, are also the main reason for the presence of whitebark pine. Within the project area are a total of 882 acres in 18 stands that have whitebark pine older than 150 years in the upper level canopy.

STAND STRUCTURE

Stand structure indicates a characteristic of stand development and how the stand will continue to develop.

Single-storied stands are most often associated with stand-replacement events, such as severe fires or clearcut harvesting.

Two-storied stands are often associated with areas of less severe fire and usually have more fire-resistant trees, such as western larch or Douglas-fir, left in the overstory. Regeneration harvests that retain approximately 10 percent crown cover in the overstory and have seedling/sapling understory are also classified as 2-storied stands.

The multistoried condition arises when a stand has progressed through time and succession to the point that shade-tolerant species are replacing a shade-intolerant overstory. Often a long interval of time occurs between major disturbances.

TABLE B-3 - PERCENT OF STAND STUCTURES IN THE PROJECT AREA AND ENTIRE STILLWATER STATE FOREST displays the percent of stands in the single-storied, two-storied, and

TABLE B-3 - PERCENT OF STAND STUCTURES IN THE PROJECT AREA AND ENTIRE STILLWATER STATE FOREST

STAND STRUCTURE	STILLWATER UNIT	PROJECT AREA
Single-storied	18%	6%
Two-storied	6%	Trace
Multistoried	76%	93%

multistoried levels on Stillwater Unit and within the project area.

PAST MANAGEMENT ACTIVITIES

Engelmann spruce and subalpine fir have always been the predominate species in the project area. According to past inventory records, western larch, Douglas-fir, and western white pine were present in many of the stands in Harvest Area II, as they are today, but Engelmann spruce and subalpine fir have always been the predominate species. In Harvest Area III, the seral species are a minor component with less than 15 percent canopy composition.

Major timber harvesting has been ongoing in the project area since the late 1940s. Many of the stands in Harvest Area II were selectively logged in the late 1940s and early 1950s, targeting Douglas-fir, Engelmann spruce, and western larch, where available, for use as railroad ties. Minimal site preparation was completed following harvesting; therefore, the progression of these stands leans toward the shade-tolerant species of Engelmann spruce and subalpine fir.

Over time, salvage logging has occurred in many of the stands in order to remove blowdown or beetle-infested trees, mainly Engelmann spruce.

Overall, there are approximately 1,600 acres in the project area that have more than 30-percent crown removal. Most (76 percent) of the acres were harvested in the 1950s and 24 percent was salvaged and clearcut. Where the ground was scarified, desired tree species were able to regenerate. However, without scarification and planting, many of these areas were taken over by shrub species, causing regeneration to be slow and limited.

FIRE REGIMES

The fire regimes across Stillwater State Forest are variable. The forest, as a whole, has a mosaic pattern that developed from different fire frequencies and intensities. Areas of frequent fire have produced Douglas-fir, western larch, and ponderosa pine covertypes. As the intervals between fires become longer, the more shade-tolerant species (Engelmann spruce, subalpine fir, grand fir, western hemlock, and western red cedar) begin to develop. The higher elevations within the forest have longer fire intervals and the stands tend to be multistoried with a dominant shade-tolerant covertype. Where fire frequencies were short, the stands are open, single-storied, and, occasionally, 2-storied. With the arrival of aggressive fire-suppression efforts, covertypes and fire frequencies were altered. Stands of ponderosa pine, western larch, and/or Douglas-fir have become multistoried with shade-tolerant species. Stands that were once open, now have a thick understory of predominantly Douglas-fir, grand fir, Engelmann spruce, and subalpine fir. Fires are generally kept small, limiting natural fire effects. If a large-scale fire were to occur, many acres could be affected due to ladder fuels, heavy fuel accumulation, and other environmental factors.

The West Fork Timber Sale Project area is primarily represented by Fire Group 9 Fire Regime (87 percent of the project area gross acreage), with minor representation in Fire Groups 10 (8 percent), 8 (5 percent), and 7 (less than 1 percent) (*Fischer and Bradley, 1987*). All stands in Harvest Area II and most stands in Harvest Area III fall into Fire Group 9. Fire Group 9 represents moist, lower subalpine habitat types where fires are infrequent, but severe, and the effects are long lasting. Fire-free

intervals range from 117 years in valleys to more than 146 years on lower alpine slopes. Within the project area, stand-replacing fires have been estimated to occur at moderately long to long intervals, 150 to 300 years. Fire history information for subalpine fir habitat types is limited, particularly for moist Fire Group 9 sites. Available evidence indicates that fires on such sites are infrequent and are mostly either low severity or stand replacing. Moderately severe fires are apparently less frequent, although they do occur. Therefore, the size of the fires in this fire regime will vary from small in the less severe fire conditions to large in the more severe fire conditions that have been experienced lately where thousands of acres in the later successional stages are burned in a stand-replacement fire.

The next most common fire regime in the project area is Fire Group 10, which is characterized by high-elevation forests near and at timberline. Some stands in Harvest Area III are in this regime. Stand-replacing fires even in the more continuous forests range in frequency to more than 300 years.

Fire Group 8 consists of dry, lower subalpine habitat types where Engelmann spruce, subalpine fir, or mountain hemlock are the indicated climax species. This group experiences more frequent fires that are generally less severe than Fire Group 9. Intervals range from 50 years in lodgepole pine stands to 130 years for the more moist, lower subalpine types.

No harvest areas are proposed in Fire Group 7; this group is less than 1 percent of the project area; therefore, this group will not be discussed further.

ALTERNATIVE EFFECTS

COVERTYPES AND AGE CLASSES

Direct Effects

- ***Direct Effects of No-Action Alternative A to Covertypes and Age Classes***

  Covertypes and age classes on Stillwater State Forest would not be directly affected.

- ***Direct Effects of Action Alternative B to Covertypes and Age Classes***

  This alternative proposes:

  - a commercial-thin harvest on 73 acres in Harvest Area I.
  - regeneration harvests, including group-selection and overstory-removal treatments, on approximately 1,174 acres in Harvest Areas II and III.

  Approximately 138 acres of the mixed-conifer covertype would likely be converted to a western larch/Douglas-fir covertype through the planting of western larch or the harvesting of subalpine fir and Engelmann spruce. An additional 351 acres of the subalpine fir covertype and 779 acres of the mixed-conifer covertype would be harvested, but no change in covertype is expected. The representation of western larch and western white pine would likely increase due to planting; Douglas-fir and whitebark pine representation should remain similar to current numbers.

  With the group-selection/overstory-removal treatments planned for Harvest Area II, approximately 713 acres would be regenerated and 153 acres would be retained in a stocked stand of saplings and pole-sized trees in the 40-to-99-year age class. Approximately 190 acres would change from the 40-to-99-year age class to 0 years, 160 acres would change from the 100-to-150-year age class to 0 years, and 695 acres would change from

the old-stand age class to 0 years.

Following site preparation and planting of Harvest Areas II and III, representation of the 0-to-39-year age class on Stillwater Unit would increase by 1 percent, or 1,045 acres, and representation of 150+-year-old stands would be reduced by 0.7 percent.

- ***Direct Effects of Action Alternative C to Covertypes and Age Classes***

  Action Alternative C proposes a commercial-thin harvest on 73 acres and group-selection and overstory-removal treatments on approximately 866 acres.

  Through the planting or removal of subalpine fir and Engelmann spruce during the thinning harvest, approximately 46 acres of the mixed-conifer covertype would likely be converted to the western larch/Douglas-fir covertype. Approximately 139 acres of the subalpine fir and 753 acres of the mixed-conifer covertypes would be harvested, but no covertype change is expected. The representation of western larch and western white pine would likely increase due to planting; Douglas-fir and whitebark pine representation should remain similar to the current numbers.

  With the group-selection/overstory-removal treatments planned for Harvest Area II, approximately 713 acres would be regenerated and 153 acres would be retained in a stocked stand of saplings and pole-sized trees in the 40-to-99-year age class. Approximately 190 acres would change from the 40-to-99-year age class to 0 years, 160 acres would change from the 100-to-150-year age class to 0 years, and 695 acres would change from the ***150-year-plus*** age class to 0 years.

  Following the site preparation for Harvest Area II, the representation of the 0-to-39-year age class on Stillwater Unit would increase by 0.7 percent or 713 acres and the representation of 150+-year-old stands would be reduced by 0.4 percent.

Indirect Effects

- ***Indirect Effects of No-Action Alternative A to Covertypes and Age Classes***

  Overtime, natural forest succession and fire suppression would reduce the variability of covertypes and age classes, thus, reducing biodiversity.

- ***Indirect Effects of Action Alternative B to Covertypes and Age Classes***

  Harvesting trees would move the representation of age classes and covertypes would move representation toward historical distribution. In total, representation of the 0-to-39-year age class on Stillwater State Forest would increase by 1 percent, or 1,045 acres, and the old-stand representation would be reduced by 0.7 percent.

- ***Indirect Effects of Action Alternative C to Covertypes and Age Classes***

  The representation of age classes and covertypes would move representation toward historical distribution. In total, representation of the 0-to-39-year age class on Stillwater State Forest would increase by 0.7 percent, or 713 acres, and the 150-year-age-class representation would be reduced by 0.4 percent.

Cumulative Effects

- ***Cumulative Effects of All Alternatives to Covertypes and Age Classes***

  The cumulative effects of timber-stand management on Stillwater State Forest is a trend toward increasing seral covertypes in areas where recent forest-management activities have taken

place. Since the Chicken/Werner Timber Sale Project EIS in 1999, the western larch/Douglas-fir covertype has increased by 6 percent.

In addition to the changes in covertype distributions from the proposed alternatives, other timber sale projects have been initiated, but have not been completed; therefore, their effects are not represented in the STW 2003 SLI. Scheduled updates of the SLI will begin to capture the trend toward more western larch/Douglas-fir, lodgepole pine, and western white pine covertypes on Stillwater State Forest, as well as the trend toward increasing the amount of acres in the 0-to-39-year age class.

OLD-GROWTH DISTRIBUTION AND ATTRIBUTES

Direct Effects

- ***Direct Effects of No-Action Alternative A to Old-Growth Distribution and Attributes***

  The distribution or attributes of old-growth stands would not be affected.

- ***Direct Effects of Action Alternative B to Old-Growth Distribution and Attributes***

  Approximately 286 acres of old-growth would be harvested with regeneration treatments on areas typically suited to stand-replacement fire regimes. The posttreatment timber stand would no longer meet DNRC's criteria for old growth. Those portions of the original stand that are not harvested would likely continue to meet DNRC's old-growth definition. ***Future SLI updates would be made on the remaining portions of the timber stands.*** Implementation of Action Alternative B would decrease Stillwater Unit's old-growth levels by 286 acres and retain an estimated 8,393 acres of potential old growth. ***Recognizing that the amounts and distributions of all age classes will shift and change over time, the amount of old growth remaining is within an expected range of natural variation.*** This harvest would remove 118 acres from the mixed-conifer covertype and 168 acres from the subalpine fir covertype.

  FIGURE III-6 - WEST FORK OLD-GROWTH MAP (next page) shows the locations where harvesting would affect the distribution of old-growth stands.

  Most attributes associated with old-growth stands would be removed. Structure would be retained in small areas where existing trees would not be harvested, such as near springs, areas that are not feasible to skid or yard, or areas that are marked with leave trees. A minimum of 1 large (greater than 21-inches dbh) snag and 1 large-diameter snag-recruitment tree per acre would be retained within the harvest areas. If no snags this size are available, the next largest size would be retained. In addition to live recruitment trees, up to 10 western larch, Douglas-fir, and whitebark pine trees per acre that are suitable for seed dispersal would be retained.

- ***Direct Effects of Action Alternative C to Old-Growth Distribution and Attributes***

  The distribution or attributes of old-growth stands would not be affected.

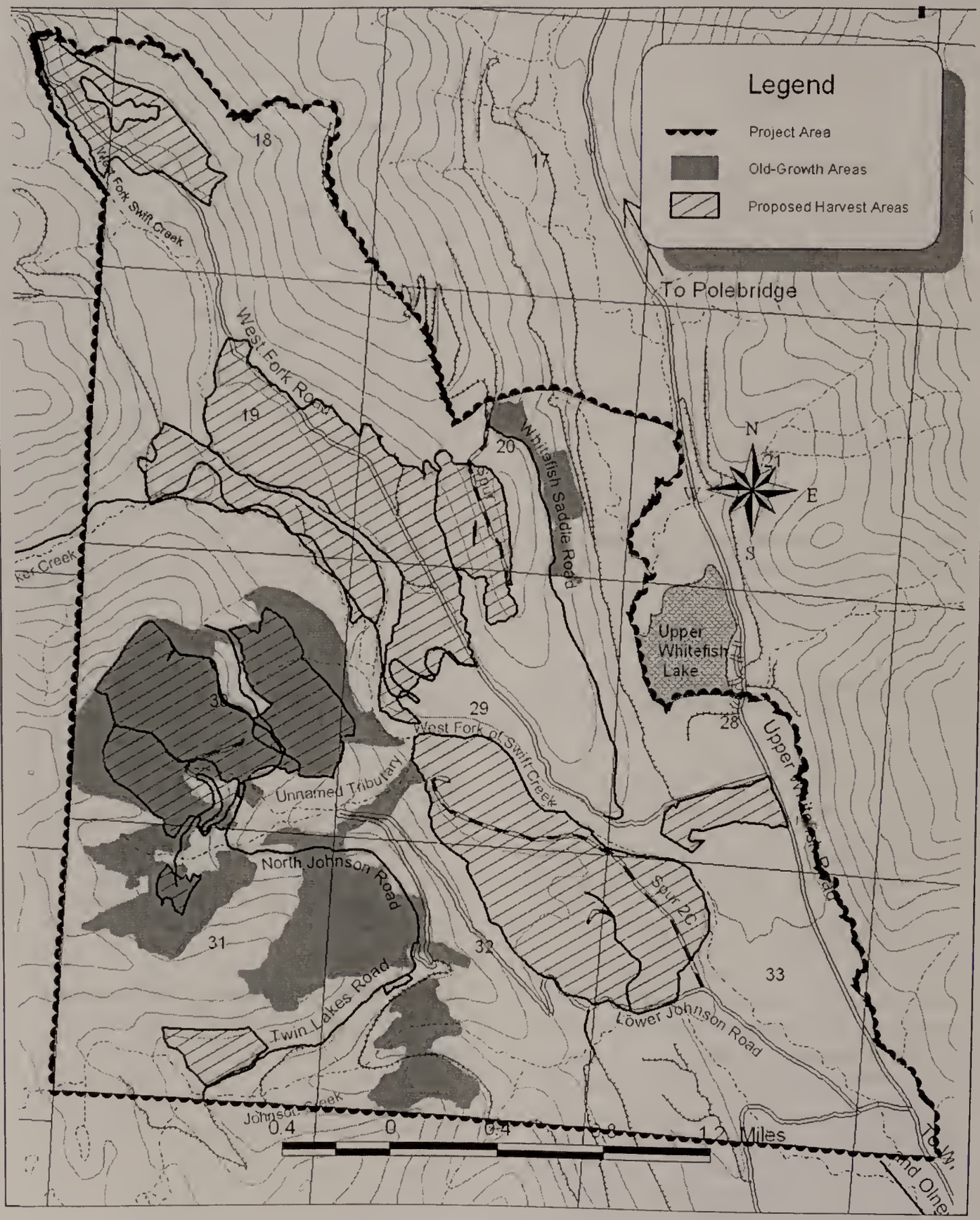
Indirect Effects

- ***Indirect Effects Common of All Alternatives to Old-Growth Distribution and Attributes***

  Stands currently meeting DNRC's old-growth definition ***and not proposed for harvesting*** would become more decadent. Stocking levels and the loading of down woody debris would increase in some stands and covertypes, increasing wildfire hazards.

Figure B-5

WEST FORK OLD-GROWTH MAP



Shade-tolerant species would remain dominant in stands. Various factors, such as insects, diseases, and decreasing vigor, would eventually cause more snags to occupy portions of the stands. Within the project area, white pine blister rust, mountain pine beetles, and weather-related damage has increased the amount of snags in old-growth stands.

- ***Indirect Effects of Action Alternative B to Old-Growth Distribution and Attributes***

  Action Alternative B would harvest timber near old-growth stands and structurally create more abrupt stand edges. ***If the proposed units in Harvest Area III are harvested, an increase in sunlight would occur along the edges of harvested and unharvested areas. This additional sunlight would increase the growth of small trees established in that zone. Regeneration may also occur, but due to site preparation not occurring, the species regenerating would likely be subalpine fir or Engelmann spruce.*** Potentially, the risk of blowdown along the proposed unit boundaries would increase and likely ***add to the down fuel loading.*** Harvest areas next to old-growth stands could possibly act as fuel breaks, which could slow or stop wildfires before they could burn the old-growth.

Cumulative Effects

- ***Cumulative Effects Common to All Alternatives to Old-Growth Distribution and Attributes***

  Approximately 48 acres of field-verified old growth ***of the Taylor South Timber Sale Project area*** are planned for harvesting in Sections 20, 29, and 32, Township 32 north, Range 22 west; the EIS ***for this project*** covered the harvesting of these acres.

  Approximately 104 acres of old growth, both field verified and SLI identified, have been harvested in the Chicken/Werner Timber Sale Project area. ***No additional old growth is proposed for harvesting in the Ewing Middle Ridge or Point of Rocks timber sale projects.*** In total, an estimated 59 acres of old growth would be removed from the mixed-conifer covertype, 81 acres from the western white pine covertype, and 12 acres from the Douglas-fir covertype.

  SLI originally classified these 152 acres as having medium attribute levels. These stands would no longer meet DNRC's old-growth definition following harvesting, and, at the most, they would have low attributes.

- ***Cumulative Effects Common of No-Action Alternative A and Action Alternative C to Old-Growth Distribution and Attributes***

  The estimated acres of old-growth on Stillwater Unit would be reduced to 8,527 acres; approximately 8.5 percent of the analysis area. The percentage of old-growth acres by covertype would change very little.

- ***Cumulative Effects of Action Alternative B to Old-Growth Distribution and Attributes***

  Old-growth on Stillwater Unit would be reduced to an estimated 8,241 acres; approximately 8.2 percent of the analysis area. ***Recognizing that the amounts and distributions of all age classes will shift and change over time, the amount of old growth remaining is within an expected range of natural variation.*** The representation of the mixed-conifer old-growth area would be reduced by about 2 percent; the representation of both the western larch/Douglas-fir and subalpine fir covertypes would increase by approximately 1 percent.

STAND DEVELOPMENT

Direct Effects

- ***Direct Effects of No-Action Alternative A to Stand Development***

  Stand development within the project area would not be directly affected.

- ***Direct Effects of Action Alternative B to Stand Development***

  This alternative would directly affect stand development by taking on the role of a stand-replacing fire in Area III, and a moderately-severe fire in Area II; a vegetative mosaic would be created by removing some overstory trees and reducing fuels. The climax species of Engelmann spruce and subalpine fir, which are easily killed by fire, would be removed, thereby allowing the regeneration of those species that require more sunlight. This alternative would likely convert approximately 138 acres of the mixed-conifer covertype to the western larch/Douglas-fir covertype (see *Direct Effects to Covertypes and Age Classes*). By removing trees that are affected by insects and diseases, the vigor and health of the residual trees, adjacent stands, and future forest would all be directly affected.

  In stands with whitebark pine, the desired future condition is a healthy, virile stand of trees with some degree of rust resistance. The cones and seeds from these trees are beneficial to wildlife. The regeneration harvests and subsequent site preparation in Areas II and III would enhance the regeneration of the seral species. The seral species are western larch, Douglas-fir, and western white pine in the stands of lower elevation and whitebark pine in the stands of higher elevations. Broadcast burning would be a benefit for reestablishing whitebark pine in these stands.

- ***Direct Effects of Action Alternative C to Stand Development***

  This alternative would directly affect stand development by taking on the role of a moderately severe fire in Area II, creating a vegetative mosaic by removing some overstory trees, and reducing fuels. The climax species of Engelmann spruce and subalpine fir, easily killed by fire, would be removed, thereby allowing the regeneration of those species that require more sunlight. Action Alternative C would likely convert approximately 46 acres of the mixed-conifer covertype to the western larch/Douglas-fir covertype (see *Direct Effects to Covertypes and Age Classes*). By removing trees that have been affected by insects and diseases, the vigor and health of the residual trees, present adjacent stands, and future forest would all be directly affected.

  The regeneration harvests and subsequent site preparation in Area II would enhance the regeneration of the seral species. The seral species are western larch, Douglas-fir, and western white pine.

Indirect Effects

- ***Indirect Effects of No-action Alternative A to Stand Development***

  As stands age over time, natural forest succession and fire suppression would reduce the variability of covertypes both on the forest landscape and in the project area. Coupled with the effects of mountain pine beetles and white pine blister rust, the representation of whitebark pine would diminish over the landscape, and the benefits to wildlife would diminish as well. Engelmann spruce and subalpine fir would continue to replace the seral species until a stand-replacing fire develops some day and allows the process of succession to begin

again. Hundreds of years may pass before this happens. With current fire-suppression efforts, surface fires that act as underburns would more likely occur, reducing fuels and killing some overstory trees. Less frequent, more severe fires could occur over small areas, but their effect would usually be limited to the creation of vegetative mosaics.

- ***Indirect Effects of Action Alternative B to Stand Development***

  In Harvest Area III, logging takes on the role of a stand-replacing fire that probably would not naturally occur except at 150- to 300-year intervals. The shade-tolerant climax species (Engelmann spruce and subalpine fir) are removed, shrub competition is reduced, and some soil is exposed to allow the seeds from the more shade-intolerant species of whitebark pine, western larch, and Douglas-fir to germinate.

  All proposed harvest units in Area II are in the Fire Group 9 fire regime, where logging imitates more of a moderately severe fire. A fire in this regime is less intense, but still effective in removing the shade-tolerant and *least fire-resistant species of Engelmann spruce and subalpine fir.*

  The resultant indirect effect on stand development across the project area is that the forest would contain a mosaic of structures to include single-storied, two-storied, and multistoried conditions. The structure changes through harvesting would emulate the type of fire regime associated with the covertype. Fire regime simulations would range from stand-replacing to mixed-severity, depending on the site preparation used and the extent that it could be employed.

- ***Indirect Effects of Action Alternative C to Stand Development***

  All of the proposed harvest units in Area II are in the Fire Group 9 fire regime, where logging would imitate more of a mixed-severity fire. A mixed-severity fire is less intense, but still effective in removing the shade-tolerant and least fire-resistant species of Engelmann spruce and subalpine fir.

  The resultant indirect effect on stand development across the project area is that the forest would contain a mosaic of structures to include single-storied, two-storied, and multistoried conditions. The changes in structure through harvesting would emulate the type of fire regime associated with the habitat type. Fire regime simulations would range from stand-replacing to mixed-severity, depending on the type of site preparation used and the extent that it could be employed.

Cumulative Effects

- ***Cumulative Effects of No-action Alternative A to Stand Development***

  Forest succession and fire suppression would continue; whitebark pine representation would continue to diminish from the landscape. Even if a fire were allowed to burn in the higher elevations, a stand-replacing fire would not likely develop. The conditions required for this type of fire are extensive drought and a severe wind-driven crown fire. The political, social, and environmental consequences are much too great for any land manager to allow this kind of

"let-burn" action to happen. This type of fire only occurs naturally, and the likelihood for this is small, even with the climatic conditions experienced in the recent past.

- ***Cumulative Effects of Action Alternative B to Stand Development***

  Natural stand development, past timber sales, and wildfires have created the current vegetative mosaic in this area. Future timber sale projects would likely continue to be planned with the potential to modify the distribution of stand development within stands. Seedling/sapling stands would continue to develop.

  Action Alternative B is an opportunity to reestablish whitebark pine seedlings on the landscape. Recent fires on higher elevation sites have also provided opportunities to reestablish whitebark pine.

- ***Cumulative Effects of Action Alternative C to Stand Development***

  Natural stand development, past timber sales, and wildfires have created the current vegetative mosaic in this area. Future timber sales would likely continue to be planned with the potential to modify the distribution of stand development within stands. Seedling/sapling stands would continue to develop.

  Recent fires on higher elevation sites have provided opportunities to reestablish whitebark pine.

Appendix C

Watershed and Hydrology Analysis

APPENDIX C
WATERSHED AND HYDROLOGY ANALYSIS

INTRODUCTION

SEDIMENT DELIVERY

Timber harvesting and related activities, such as road construction, can lead to water-quality impacts by increasing the production and delivery of fine sediment to streams. The construction of roads, skid trails, and landings can generate and transfer substantial amounts of sediment through the removal of vegetation and exposure of bare soil. In addition, removal of vegetation near stream channels reduces the sediment-filtering capacity and may reduce channel stability and the amounts of large woody material. Large woody debris, which creates natural sediment traps and energy dissipaters to reduce the velocity and erosiveness of stream flows, is a very important component of stream dynamics.

WATER YIELD

Timber harvesting and associated activities can affect the timing, distribution, and amount of water yield in a harvested watershed. Water yields increase proportionately to the percentage of canopy removal, because removal of live trees reduces the amount of water transpired, leaving more water available for soil saturation and runoff. Canopy removal also decreases interception of rain and snow and alters snowpack distribution and snowmelt, which lead to further water-yield increases. Higher water yields may lead to increases in peak flows and peak-flow duration, which can result in accelerated streambank erosion and sediment deposition.

ANALYSIS METHODS

SEDIMENT DELIVERY

Methodology for analyzing sediment delivery was completed using a sediment-source inventory. Roads and stream crossings within the project area were evaluated to determine sources of introduced sediment. In addition, in-channel sources of sediment were identified using channel-stability rating methods developed by *Pfankuch* and through the conversion of stability rating to reach condition by stream type developed by *Rosgen (1990)*. These analyses were conducted in 1999 by a contracted firm and verified by a DNRC hydrologist. In addition, data was collected in 2003 to quantify sediment delivery using procedures adapted from the *Washington Forest Practices Board (Callahan, 2000)*.

WATER YIELD

The water-yield increase for the watershed in the project area was determined using the equivalent clearcut area (ECA) method as outlined in *Forest Hydrology Part II (1976)*. ECA is a function of total area roaded and harvested, percent of crown removal in harvesting, and amount of vegetative recovery that has occurred in harvested areas. This method equates area harvested and percent of crown removed with an equivalent amount of clearcut area. For example, if 100 acres had 60 percent crown removed, ECA would be approximately 60, or equivalent to a 60-acre clearcut. The relationship between crown removal and ECA is not a 1-to-1 ratio, so the percent ECA is not always the same as the percent of canopy removal. As live trees are removed, the water they would have evaporated and transpired either saturates the soil or is

translated to runoff. This method also calculates the recovery of these increases as new trees vegetate the site and move toward preharvest water use.

In order to evaluate the watershed risk of potential water-yield increase effectively, a threshold of concern must be established. Acceptable risk level, resource value, and watershed sensitivity are evaluated according to *Young (1989)* in order to determine a threshold of concern. The watershed sensitivity is evaluated using qualitative assessments, as well as procedures outlined in *Forest Hydrology Part II (1976)*. The stability of a stream channel is an important indicator of where a threshold of concern should be set. As water yields increase as a result of canopy removal, the amount of water flowing in a creek gradually increases. When these increases reach a certain level, the bed and banks may begin to erode. The more stable streams will be able to handle larger increases in water yield before they begin to erode, while less stable streams will experience erosion at more moderate water-yield increases.

ANALYSIS AREA

SEDIMENT DELIVERY

The analysis area for sediment delivery is the West Fork Timber Sale project area and the proposed haul routes. The West Fork watershed is a 10,669-acre, perennial, third-order tributary to Swift Creek and Whitefish Lake and includes Stryker Creek. The Antice/Johnson watershed is a 7,289-acre tributary to Swift Creek. Analysis will cover stream segments within these watersheds that may be affected by the proposed project and all roads and upland sites that may contribute sediment to the West Fork or Johnson Creek.

WATER YIELD

The analysis area for water yield is the West Fork and Antice/Johnson Creek watersheds. Precipitation in both watersheds range from 30 inches in the Antice/Johnson watershed in the lower elevations to 80 inches at the ridgetops. In addition, the water yield of the entire Swift Creek watershed will be analyzed to determine the effects of the proposed project on the receiving waters.

EXISTING CONDITIONS

REGULATORY FRAMEWORK

Montana Surface Water-Quality Standards

According to *ARM 17.30.608 (1)(c)*, the Whitefish Lake drainage, including Swift Creek, is classified as A-1. Among other criteria for A-1 waters, no increases are allowed above naturally occurring levels of sediment or turbidity. "Naturally occurring," as defined by *ARM 17.30.602 (17)*, includes conditions or materials present during runoff from developed land where all reasonable land, soil, and water conservation practices (commonly called BMPs) have been applied. Reasonable practices include methods, measures, or practices that protect present and reasonably anticipated beneficial uses. These practices include, but are not limited to, structural and nonstructural controls and operation and maintenance procedures. Appropriate practices may be applied before, during, or after completion of potentially impactive activities.

Designated beneficial water uses within the project area include cold-water fisheries and recreational use in the streams, wetlands, lake, and surrounding area.

Water-Quality-Limited Waterbodies

Swift Creek and the West Fork of Swift Creek are currently listed as a water-quality-limited waterbodies in the 1996 and 2004 303(d) list. The 303(d) list is compiled by DEQ as required by Section 303(d) of the Federal Clean Water Act and the Environmental Protection Agency (EPA) Water Quality Planning and Management Regulations (*40 CFR, Part 130*). Under these laws, DEQ is required to identify waterbodies that do not fully meet water-quality standards, or where beneficial uses are threatened or impaired. These waterbodies are then characterized as "water-quality limited" and thus targeted for TMDL development. The TMDL process is used to determine the total allowable amount of particulates in a waterbody of the watershed. Each contributing source is allocated a portion of the allowable limit. These allocations are designed to achieve water-quality standards.

The Montana Water Quality Act (*MCA 75-5-701-705*) also directs the DEQ to assess the quality of State waters, ensure that sufficient and credible data exists to support a 303(d) listing, and develop TMDL for those waters identified as threatened or impaired. Under the Montana TMDL Law, new or expanded nonpoint-source activities affecting a listed waterbody may commence and continue provided they are conducted in accordance with all reasonable land, soil, and water conservation practices and BMPs. TMDLs have not been completed for the Swift Creek or West Fork drainages. DNRC will comply with the Law and interim guidance developed by DEQ through implementation of all reasonable soil and water conservation practices, including BMPs and Forest Management Rules.

The current listed causes of impairment in Swift Creek are bank erosion, other habitat alterations, and nutrients. The probable source for Swift Creek is listed as silviculture. Current listed causes of impairment in the West Fork are flow alteration, other habitat alteration, and siltation. The probable sources for the West Fork are listed as silviculture, highway maintenance, and runoff.

Montana SMZ Law

By the definition in *ARM 36.11.312 (3)*, the majority of the West Fork and Johnson Creek watersheds are Class 1 streams. Johnson Creek, the West Fork, and many of their tributaries have flow for more than 6 months each year. Many of these stream reaches also support fish. Some of the smaller first-order tributaries may be classified as Class 2 or 3 based on site-specific conditions.

SEDIMENT DELIVERY

According to field reconnaissance in the summers of 1999, 2000, and 2003, stream channels in the West Fork watershed are primarily in good to fair condition. Six reaches were rated in poor condition. These 6 reaches represent approximately 7 percent of the identified reaches in the West Fork, and approximately 16 percent of the total length of streams in the watershed. The primary reason for poor reach ratings is movement of channel-bed material. Most reaches were rated as B3 and B4 channels by a classification system developed by *Rosgen (1990)*. Channel types rated as "B" are typically in the 2- to 4-percent gradient range and have a moderate degree of meander (sinuosity). Channel-bed materials in B3 and B4 types are mainly cobble and gravel. Given the cobble and gravel beds, and the gradient of these stream types, bed materials commonly move. Gravel bars have formed on point bars in these reaches. No areas of down-cut channels were identified during field reconnaissance. Large woody debris was found in adequate supply to allow proper hydrologic function.

For further analysis of large woody debris, see *APPENDIX E -FISHERIES ANALYSIS*. Little evidence of past streamside harvesting was found, and, where past logging had taken place in the riparian area, the streams did not appear to be deficient in existing or potential downed woody material.

The existing road system leading to and in the proposed project area was reviewed for potential sources of sediment. The road system in the West Fork watershed is contributing an estimated 25.5 tons per year of sediment to streams. Roads proposed for hauling in the project area in the Johnson Creek watershed are contributing an estimated 5.2 tons of sediment per year to streams. These sediment-delivery values are estimates based on procedures outlined above and are not measured values.

Estimated sediment delivery occurs primarily at stream crossings and comes from a variety of sources. In the upper reaches of the West Fork in Stryker Basin, 3 existing crossings are constructed of wood and earth that are in various stages of decay; another structure is located on an unnamed tributary of the West Fork. Combined, these structures are contributing an estimated 2.8 tons of sediment per year. In addition, each site is at high risk for failure due to decaying wood. In total, these 3 structures are comprised of approximately 760 tons of sediment, most of which, upon failure, would be delivered to the West Fork and Stryker Creek. Other sources of sediment delivery found during the inventory were a result of sites needing erosion-control devices installed on old roads that had been used before the adoption of forest management BMPs.

Much of the existing road system in the proposed project area meets applicable BMPs. Past project work has installed surface drainage on the road systems in Stryker and Herrig basins, as well as on the major routes in the West Fork watershed.

WATER YIELD

The allowable water-yield increase for the West Fork watershed has been set at 10 percent based on channel-stability evaluations, watershed sensitivity, and acceptable risk. This water-yield increase would be reached when the ECA level in the West Fork reaches the allowable level of 2,667. Timber harvesting and associated road construction activities have taken place in the West Fork watershed since the 1930s. These activities, combined with vegetative recovery, have led to an estimated 3.4 percent water-yield increase over an unharvested condition in the West Fork watershed. ***Currently, the water yield increases in the Antice/Johnson and Swift Creek watersheds are 3.5 percent and 3.4 percent, respectively.*** *TABLE C-1 - CURRENT WATER-YIELD AND ECA INCREASES* ***BY WATERSHED*** summarizes the existing conditions for water yield in the *3* watersheds.

TABLE C-1 - CURRENT WATER-YIELD AND ECA INCREASES BY WATERSHED

	WEST FORK	*ANTICE/JOHNSON*	*SWIFT CREEK*
Percent WYI	3.4	*3.5*	*3.4*
Allowable WYI	10	*10*	*10*
Existing ECA	876	*641*	*4,833*
Allowable ECA	2,667	*1,822*	*12,362*
Remaining ECA	1,791	*1,181*	*7,529*

ALTERNATIVE EFFECTS

SEDIMENT DELIVERY

Direct and Indirect Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Sediment Delivery***

  No-Action Alternative A would have no direct effects to sediment delivery beyond those currently occurring. Existing sources of sediment, both in-channel and out of channel, would continue to recover or degrade based on natural or preexisting conditions.

  The indirect effects would be an increased risk of sediment delivery to streams from crossings that do not meet applicable BMPs. These sites would continue to pose a risk of sediment delivery to streams until other funding became available to repair them.

- ***Direct and Indirect Effects Common to Both Action Alternatives***

  Each of the proposed action alternatives would replace the wooden West Fork bridge on Stryker Basin Road. Each of the action alternatives would also remove and rehabilitate 3 log and earth-fill crossings in the upper reaches of Stryker Basin.

  Replacement of the existing bridge over the West Fork would involve removal of log-crib walls and the fill material that they are currently retaining. The existing structure is beginning to decay and, over time, would become an increasing risk of failure due to decay in the wood. A potential failure of the wood cribbing could allow several tons of sediment to enter the stream. The proposed new bridge would be designed to allow the stream to flow freely with no constriction of the bank-full channel. This would reduce the potential for bank erosion and channel down-cutting that may occur with vertical bridge abutments. The new crossing would also divert overland flow from the road surface away from the crossing site in both directions. This would lead to a decrease in delivery of approximately 0.11 tons of sediment per year at this site.

  Removal and rehabilitation of the 3 log/earth crossings in upper Stryker Basin would remove potential sources of sediment, as well as reduce current sediment delivery by approximately 2.22 tons per year for all 3 sites. As stated above, these 3 sites contain an estimated 750 tons of fill material. Removal and disposal of this material outside of the SMZ would remove the risk of this material being delivered to the West Fork and Swift Creek.

- ***Direct and Indirect Effects of Action Alternative B to Sediment Delivery***

  Several stream crossings would be replaced in the West Fork and Johnson Creek watersheds and along the proposed haul route. Erosion control and BMPs would be improved on approximately 31 miles of existing road. This work would decrease the estimated sediment load to the West Fork by approximately 4.2 tons of sediment per year, and reduce the estimated sediment load to Johnson Creek by approximately 2.7 tons per year. See *TABLE C-2 - SEDIMENT-DELIVERY ESTIMATES IN THE WEST* FORK for a

TABLE C-2 - SEDIMENT-DELIVERY ESTIMATES IN THE WEST FORK

	West Fork Alternative			Johnson Creek Alternative		
	A	B	C	A	B	C
Postproject delivery (tons per year)	25.5	21.3	22.9	5.2	2.5	5.2
Reduction (tons per year)	0	4.2	2.6	0	2.7	0
Reduction percent	0	16%	10%	0	52%	0

summary of sediment-delivery estimates.

Crossings proposed for replacement do not currently meet all applicable BMPs and require a new culvert or bridge in order to meet applicable standards. The replacement of existing stream crossings would contribute sediment directly to the West Fork. This sediment would be minimized through the application of standard erosion-control measures. The sediment delivery anticipated from this project would be short term and comply with all applicable permits and State water-quality laws. In addition, several sites would have additional erosion-control measures added to lower the risk of sediment delivery to a stream or draw. In some cases, the addition of erosion-control measures may increase the risk of sediment delivery in the short term by creating bare soil. However, as these sites revegetate, the long-term risk of sedimentation to a stream would be reduced to levels lower than the existing condition.

This alternative would also construct approximately 1.0 mile of new road to access proposed Harvest Area I, approximately 2.1 miles of temporary road in proposed Harvest Areas II-C, and 0.3 mile of new road to Harvest Area III-J. Reclamation of the temporary roads would occur immediately following completion of activities in the proposed harvest areas. The reclaimed road would present an increased risk of sediment delivery until bare soil revegetated.

Action Alternative B would have a very low risk of sediment delivery to streams as a result of the proposed timber-harvesting activities. Some harvesting activities may occur within designated SMZs. This harvesting activity would follow all requirements of the SMZ Law and have a low risk of affecting recruitment of large woody material to the West Fork, Johnson Creek, or their tributaries. The SMZ law, rules, and all applicable BMPs would be applied to all harvesting activities, which would minimize the risk of sediment delivery to draws and streams.

- ***Direct and Indirect Effects of Action Alternative C to Sediment Delivery***

  Several stream crossings would be replaced in the West Fork watershed and along the proposed haul route, and erosion control and BMPs would be improved on approximately 25 miles of existing road. This work would decrease the estimated sediment load to the West Fork by approximately 2.6 tons of sediment per year.

  Crossings proposed for replacement do not currently meet all applicable BMPs; to meet applicable standards, a new culvert or bridge is required. The replacement of existing stream crossings would contribute sediment directly to the West Fork. This sediment would be minimized through application of standard erosion-control measures. The sediment delivery anticipated from this project would be short term and comply with all applicable permits and State water-quality laws. Also, additional erosion control would be added to several sites to lower the risk of sediment delivery to a stream or draw. In some cases, the addition of erosion-control measures may increase the risk of sediment delivery in the short term by creating bare soil. However, as these sites revegetate, the long-term risk of sedimentation to a stream would be reduced to levels lower than the existing condition.

  This alternative would also construct approximately 1.0 mile

of new road to access proposed Harvest Area I and approximately 2.1 miles of temporary road in Harvest Area II-C of the proposed project area. Reclamation of the temporary road would occur immediately following completion of activities in the proposed harvest areas. The reclaimed road would present an increased risk of sediment delivery until bare soil revegetated.

Action Alternative C would have a very low risk of sediment delivery to streams as a result of proposed timber-harvesting activities. Some harvesting activities may occur within designated SMZs; these harvesting activities would follow all requirements of the SMZ Law, and would have a low risk of affecting recruitment of large woody material to the West Fork, Johnson Creek, or their tributaries. The SMZ law, rules, and all applicable BMPs would be applied to all harvesting activities, which would minimize the risk of sediment delivery to draws and streams. (See *TABLE C-2 - SEDIMENT-DELIVERY ESTIMATES IN THE WEST* FORK for a summary of sediment-delivery estimates.)

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A to Sediment Delivery***

  The cumulative effects of sediment delivery would be very similar to those described in the existing conditions portion of this analysis. All existing sources of sediment would continue to recover or degrade as dictated by natural and preexisting conditions until a source of funding became available to repair them. Sediment loads would remain at or near present levels.

- ***Cumulative Effects of Action Alternative B to Sediment Delivery***

  Cumulative effects to sediment delivery would be primarily related to roadwork, stream-crossing replacements, and rehabilitations. The sediment generated from the replacement of existing culverts would increase the total sediment load in the West Fork for the duration of activity. These increases would not exceed any State water-quality laws and would follow all applicable recommendations given in 124 and 318 permit applications. In the long term, the cumulative effects to sediment delivery would be a reduction from approximately 25.5 tons of sediment per year to 21.3 tons of sediment per year in the West Fork, and a reduction from approximately 5.2 tons per year to 2.5 tons per year in Johnson Creek. A summary of sediment-delivery estimates is found in *TABLE C-2 - SEDIMENT-DELIVERY ESTIMATES IN THE WEST FORK.* As the sites stabilize and revegetate, sediment levels resulting from culvert replacements would decrease further from projected levels as work sites, and closed and reclaimed roads revegetate and stabilize. Over the long term, cumulative sediment loads would be reduced due to better designed crossings. Improved design would reduce the risk of structure failure, which would reduce the risk of sediment delivery to Swift Creek and other downstream waters.

  The installation and improvement of erosion-control and surface-drainage features on existing roads would also affect the cumulative sediment delivery to the West Fork and Johnson Creek, as described above. In the short term, the installation and improvement of surface-drainage features would expose bare soil. This would increase the risk of sediment delivery to the streams in and around the proposed project area. The application of all applicable BMPs during this work would make increased sediment

loads unlikely. Over the long term, with the installation of more effective surface-drainage and erosion-control features on the existing road system, cumulative sediment delivery to the West Fork and Johnson Creek is projected to be lower than existing conditions.

Harvesting trees within an SMZ would have a low risk of adverse cumulative effects to downed woody material in the West Fork watershed. The tree-retention requirements of the SMZ Law and the application of Forest Management Rules would ensure a future supply of woody material to the creeks.

None of the cumulative impacts described above are expected to adversely affect downstream beneficial uses. All activities would comply with applicable laws, rules, and regulations.

- ***Cumulative Effects of Action Alternative C to Sediment Delivery***

  Cumulative effects to sediment delivery would be primarily related to roadwork and stream-crossing replacements. The sediment generated from replacing existing culverts would increase the total sediment load in the West Fork for the duration of the activity. These increases would not exceed any State water-quality laws, and would follow all applicable recommendations given in the 124 and 318 permit applications. In the long term, the cumulative effects to sediment delivery would be a reduction from approximately 25.5 tons of sediment per year to approximately 22.9 tons of sediment per year in the West Fork. *TABLE C-2 - SEDIMENT-DELIVERY ESTIMATES IN THE WEST FORK* summarizes sediment-delivery estimates. As the sites stabilize and revegetate, sediment levels resulting from culvert replacements would decrease further from projected levels as work sites and closed and reclaimed roads revegetate and stabilize. Over the long term, cumulative sediment loads would be reduced due to a better crossing design. Improved design would reduce the risk of structure failure, which would reduce the risk of sediment delivery to Swift Creek and other downstream waters.

  The installation and improvement of erosion-control and surface-drainage features on existing roads would also affect the cumulative sediment delivery to the West Fork as described above. In the short term, the installation and improvement of surface drainage features would expose bare soil, which would increase the risk of sediment delivery to the streams in and around the proposed project area. The application of all applicable BMPs during this work would make increased sediment loads unlikely. Over the long term, with the installation of more effective surface drainage and erosion control features on the existing road system, cumulative sediment delivery to the West Fork is projected to be lower than existing conditions.

  Harvesting trees within an SMZ would have a low risk of adverse cumulative effects to downed woody material in the West Fork or its tributaries. The tree-retention requirements of the SMZ Law would ensure a future supply of woody material to the creeks.

  None of the cumulative impacts described above are expected to adversely affect downstream beneficial uses. All activities would comply with applicable laws, rules, and regulations.

WATER YIELD

Direct and Indirect Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Water Yield***

  This alternative would have no direct or indirect effects on water yield. Water quantity would not be changed from present levels.

- ***Direct and Indirect Effects of Action Alternative B to Water Yield***

  The annual water yield in the West Fork watershed would increase by an estimated 2.6 percent over the current level, ***Antice/***Johnson ***watershed*** would increase by 0.4 percent, ***and the entire Swift Creek watershed would increase by 0.8 percent.*** These levels of water-yield increases would not be sufficient to create unstable channels.

- ***Direct and Indirect Effects of Action Alternative C to Water Yield***

  The annual water yield in the West Fork watershed would increase by an estimated 1.7 percent over the current level, ***Antice/***Johnson ***watershed would*** increase by 0.2 percent, ***and the entire Swift Creek watershed would increase by 0.5 percent.*** These levels of water-yield increases would not be sufficient to create unstable channels.

CUMULATIVE EFFECTS

- ***Cumulative Effects of No-Action Alternative A to Water Yield***

  This alternative would have no cumulative effects on water yield. Existing timber harvest units would continue to revegetate and move closer to premanagement levels of water use and snowpack distribution.

- ***Cumulative Effects of Action Alternative B to Water Yield***

  The removal of trees proposed in Action Alternative B would increase the water yield in the West Fork watershed from its current level of approximately 3.4 percent over unharvested to an estimated 6.0 percent. This water-yield increase and its associated ECA level includes the impacts of all past-management activity, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the West Fork watershed. The water-yield increase expected from Action Alternative B leaves the watershed well below the established threshold of concern. No impacts to water quality are expected as a result of this alternative. A summary of the anticipated water-yield impacts of Action Alternative B to the West Fork, Antice/Johnson watershed, and the entire Swift Creek drainage is found in *TABLE C-3 - WATER YIELD AND ECA INCREASES IN THE WEST FORK; TABLE C-4 - WATER YIELD AND ECA INCREASES IN ANTICE/JOHNSON WATERSHED;* and *TABLE C-5 - WATER YIELD AND ECA INCREASES IN THE SWIFT CREEK WATERSHED (INCLUDING WEST FORK AND ANTICE/JOHNSON).*

- ***Cumulative Effects of Action Alternative C to Water Yield***

  The removal of trees would increase the water yield in the West Fork watershed from its current level of approximately 3.4 percent over unharvested to an estimated 5.1 percent. This water-yield increase and its associated ECA level includes the impacts of all past management activity, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the West Fork watershed. The water-yield increase expected from Action Alternative C leaves the watershed well below the established threshold of concern. No impacts to water quality are expected as a result of this alternative. A summary of the anticipated water-yield impacts of Action Alternative C to the West

Fork, Antice/Johnson watershed, and the entire Swift Creek drainage is found in *TABLE C-3 - WATER-YIELD AND ECA INCREASES IN THE WEST FORK; TABLE C-4 - WATER-YIELD AND ECA INCREASES IN ANTICE/JOHNSON WATERSHED;* and *TABLE C-5 - WATER-YIELD AND ECA INCREASES IN THE SWIFT CREEK WATERSHED (INCLUDING WEST FORK AND ANTICE/JOHNSON).*

TABLE C-3 - WATER-YIELD AND ECA INCREASES IN THE WEST FORK

	ALTERNATIVE		
	A	B	C
Allowable WYI (percent)	10	10	10
Percent of WYI	3.4	6.0	5.1
Acres harvested	0	1,180	883
Miles of new road	0	1.0	0.7
ECA generated	0	1,114	822
Total ECA	876	1,992	1,700
Remaining ECA	1,791	675	967
Allowable ECA	2,667	2,667	2,667

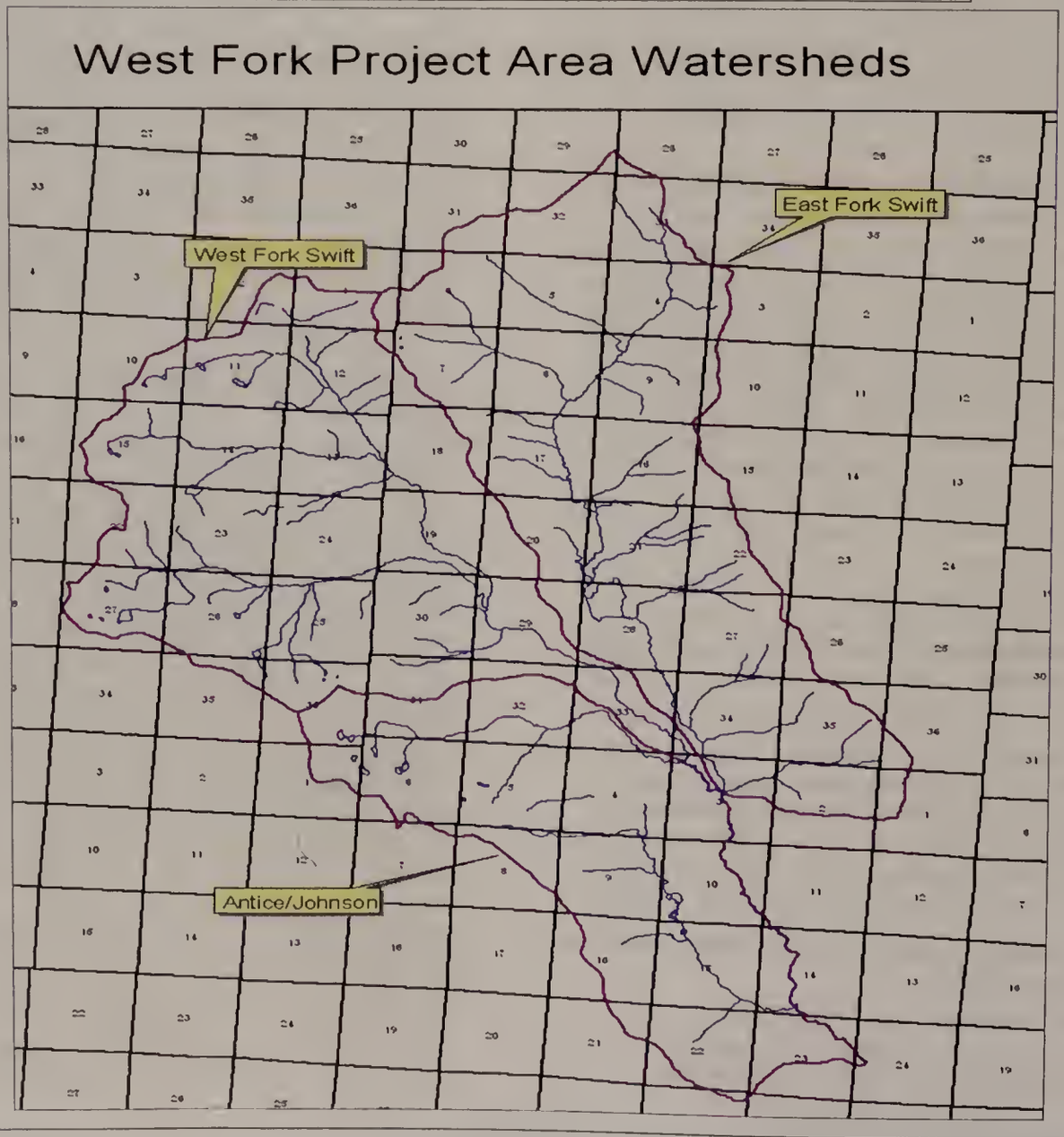
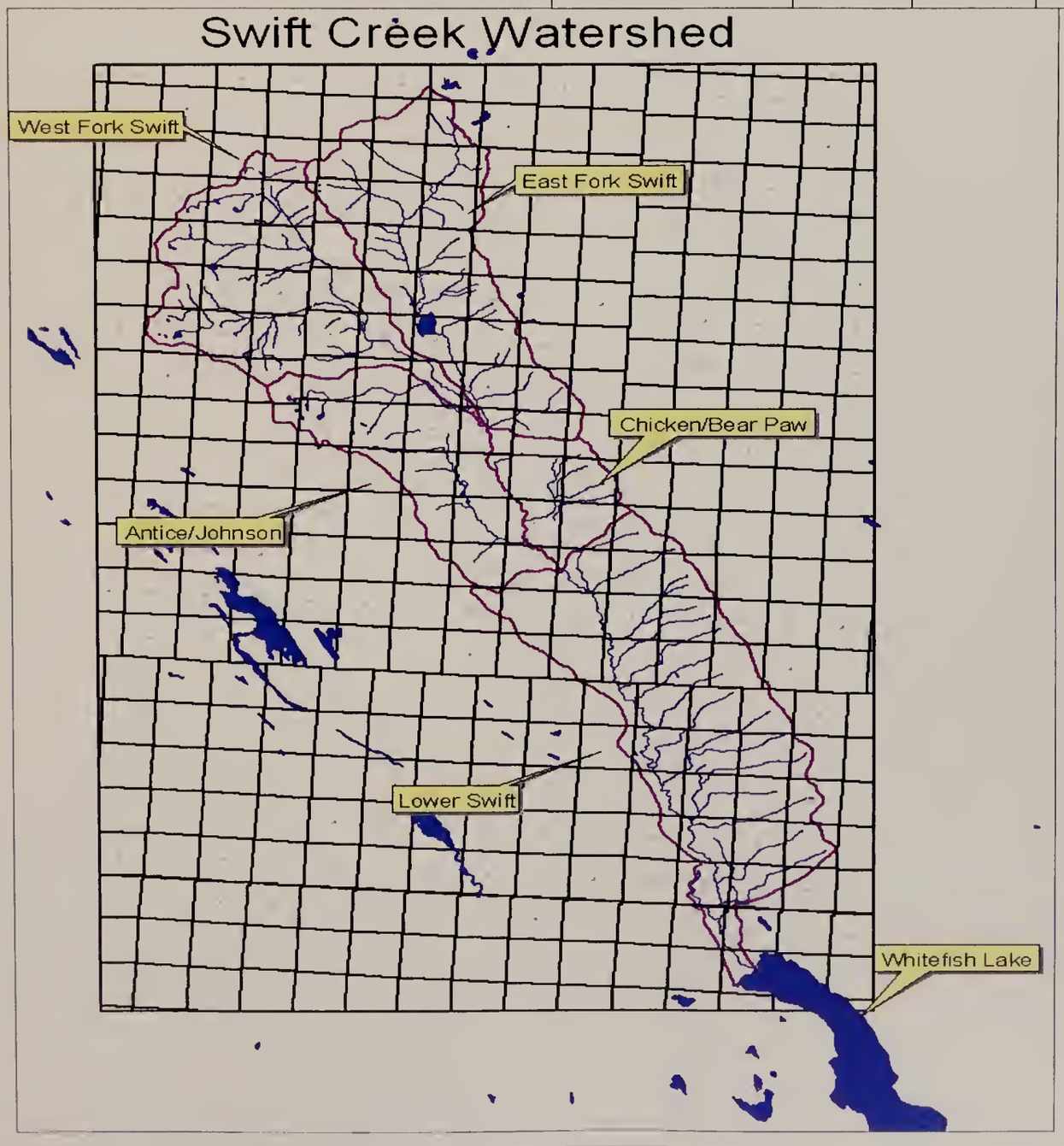


TABLE C-4 - WATER-YIELD AND ECA INCREASES IN THE ANTICE/JOHNSON WATERSHED

	ALTERNATIVE		
	A	B	C
Allowable WYI (percent)	10	10	10
Percent WYI	3.5	3.9	3.7
Acres harvested	0	94	60
Miles of new road	0	0	0
ECA generated	0	91	57
Total ECA	641	732	698
Remaining ECA	1,181	1,090	1,124
Allowable ECA	1,822	1,822	1,822

TABLE C-5 - WATER-YIELD AND ECA INCREASES IN THE SWIFT CREEK WATERSHED (INCLUDING THE WEST FORK AND ANTICE/JOHNSON)

	ALTERNATIVE		
	A	B	C
Allowable WYI (percent)	10	10	10
Percent WYI	3.4	4.2	3.9
Acres harvested	0	1,275	943
Miles of new road	0	1.0	0.7
ECA generated	0	1,204	879
Total ECA	4,833	6,040	5,714
Remaining ECA	7,529	6,322	6,648
Allowable ECA	12,362	12,362	12,362



Appendix D

Soils
Analysis

APPENDIX D
SOILS ANALYSIS

INTRODUCTION

The Swift Creek watershed is a valley formed by glaciers and river processes. The dominant soil types found in the project area are deep glacial tills derived from argillite, siltite, and limestone from the Belt Supergroup. Upper slopes and ridges are weathered bedrock scoured by glaciers.

ANALYSIS METHODS

Soil productivity will be analyzed ***through aerial photo interpretation of past harvesting activities, field verification of aerial photo interpretation, and*** by evaluating the current levels of soil disturbance in the proposed project area. Analysis criteria will also include soil stability risk factors.

ANALYSIS AREA

The analysis area for evaluating soil productivity will include State-owned land within the West Fork Timber Sale Project area. The proposed project area is within both the West Fork and Antice/Johnson watersheds.

EXISTING CONDITION

In the West Fork watershed, DNRC has conducted timber harvesting since the 1940s. Since timber sale records dating back to the 1960s, 3,291 acres of State land have been harvested ***(approximately 775 acres are within within the proposed project area)***, using a combination of ground-based and cable-yarding harvest methods. Ground-based yarding can affect soil productivity through displacement and compaction of productive surface layers of soil, mainly on heavily used trails. Field review and aerial photos of the proposed project area show that ***approximately 775 acres*** of the proposed project area has been harvested in the past. ***Based on a review of 1964 aerial photos, 10 to 15 percent of the previously harvested areas contained skid trails.*** Field reconnaissance shows that many of the existing trails from past management are well vegetated and past impacts are ameliorating from frost and vegetation. ***No erosion was observed on existing trails. The erosion-control status of the existing road system is addressed in the watershed analysis of this document.***

Soil types in the project area vary from nearly level wetland types along the West Fork to steep valley sideslopes on ridges. The Flathead National Forest Soil Survey identified one area of soils at high risk for mass movements in the project area. This soil type is landtype 74 and is found in the northern portion of the proposed project area. ***No unique geology is known to exist and*** no slope failures were identified in the proposed project area during reconnaissance. A list of soil types found in the West Fork Timber Sale Project area and their associated management implications are found in *TABLE D-1—SUMMARY OF DIRECT EFFECTS OF ALTERNATIVES ON SOILS WITH SUMMER HARVESTING.*

ALTERNATIVE EFFECTS

DIRECT AND INDIRECT EFFECTS

- ***Direct and Indirect Effects of No-Action Alternative A on Soils***

  Soil productivity would not be directly or indirectly affected. No ground-based activity would take place, which would leave the soil in the project area unchanged from the description in the *EXISTING CONDITION* portion of this analysis.

- ***Direct and Indirect Effects of Action Alternative B on Soils***

  This alternative would have direct impacts on approximately 158 acres. Direct impacts would include compaction and displacement resulting from use of ground-based equipment to skid logs on approximately 937 acres, and use of cable-yarding equipment on approximately 333 acres. Ground-based site preparation and road construction would also generate direct impacts to the soil resource. *TABLE D-1—SUMMARY OF DIRECT EFFECTS OF ALTERNATIVES ON SOILS WITH SUMMER HARVESTING* summarizes the expected impacts to the soil resource as a result of Action Alternative B. These activities would leave up to 12 percent of the proposed harvest units in an impacted condition. DNRC expects to maintain long-term soil productivity based on the implementation of mitigation measures to control the area and degree of detrimental soil impacts to less than 15 percent of the proposed harvest area. ***This range of soil effects is achievable based on past monitoring.*** A combination of skidding mitigation measures would include:

  - restricting the season of use,
  - utilizing a minimum skid-trail spacing,
  - installing erosion control where needed,
  - ***restricting ground skidding to slopes of less than 45 percent***, and
  - following all applicable BMPs.

  DNRC would require that proportions of snags, coarse woody debris, and fine litter for nutrient cycling and wildlife needs be retained. DNRC's goals for coarse-woody-debris levels are based on research by Graham et al 1994.

- ***Direct and Indirect Effects of Action Alternative C on Soils***

  Approximately 131 acres would be directly impacted. Direct impacts would include compaction and

TABLE D-1 - SUMMARY OF DIRECT EFFECTS OF ALTERNATIVES ON SOILS WITH SUMMER HARVESTING

DESCRIPTION OF PARAMETER	NO-ACTION ALTERNATIVE A	ACTION ALTERNATIVE B	ACTION ALTERNATIVE C
Acres of harvest	0	1,270	938
Acres of tractor yarding	0	937	866
Acres of skid trails and landings[1]	0	188	173
Acres of cable yarding	0	333	72
Acres of yarding corridors[2]	0	33	7
Acres of moderate impacts[3]	0	158	131
Percent of harvest area with impacts	0%	12.4%	14.0%

[1]20 percent of ground based area
[2]5 to 10 percent of cable yarding units
[3]75 percent of ground-based skid trails and 50 percent of cable corridors

displacement resulting from use of ground-based equipment to skid logs on approximately 866 acres and cable-yarding equipment on approximately 72 acres. Ground-based site preparation and road construction would also generate direct impacts to the soil resource. *TABLE D-1—SUMMARY OF DIRECT EFFECTS OF ALTERNATIVES ON SOILS WITH SUMMER HARVESTING* summarizes the expected impacts to the soil resource as a result of Action Alternative C. These activities would leave up to 14 percent of the proposed harvest units in an impacted condition. DNRC expects to maintain long-term soil productivity based on the implementation of mitigation measures to control the area and degree of detrimental soil impacts to less than 15 percent of the proposed harvest area. ***The range of soils effects is achievable based on past monitoring.*** A combination of skidding mitigation measures would include:

- restricting the season-of-use,
- utilizing a minimum skid-trail spacing,
- installing erosion control where needed,
- ***restricting ground skidding to slopes of less than 45 percent***, and
- following all applicable BMPs.

DNRC would require that proportions of snags, coarse woody debris, and fine litter for nutrient cycling and wildlife needs be retained. DNRC's goals for coarse-woody-debris levels are based on research by Graham et al 1994.

CUMULATIVE EFFECTS

- ***Cumulative Effects of No-Action Alternative A to Soils***

  This alternative would have no cumulative impacts on soil productivity. No soil would be disturbed and no past harvest units would be reentered. Cumulative effects of this alternative would be similar to those described under the *EXISTING CONDITION* portion of this analysis.

- ***Cumulative Effects Common to Action Alternatives B and C to Soils***

  Both action alternatives would enter several stands where previous timber management has occurred. Cumulative effects to soils may occur from repeated entries into a forest stand where additional ground is impacted by equipment operations. DNRC would maintain long-term soil productivity and minimize adverse cumulative effects by implementing any or all of the following ***mitigations specific to harvest units***:

  - If properly located and spaced, existing skid trails from past harvesting activities would be used.
  - Additional skid trails would be used only where existing trails are unacceptable.
  - The potential direct and indirect effects would be mitigated with soil moisture restrictions, season of operation, ***limiting ground skidding to slopes of less than 45 percent, and use of equipment suited to slopes and soil types.***
  - A portion of coarse woody debris and fine litter would be retained for nutrient cycling.

  In previously unharvested stands, cumulative effects to soil productivity from multiple entries would be the same as those listed in the direct and indirect effects sections.

West Fork Soil Types

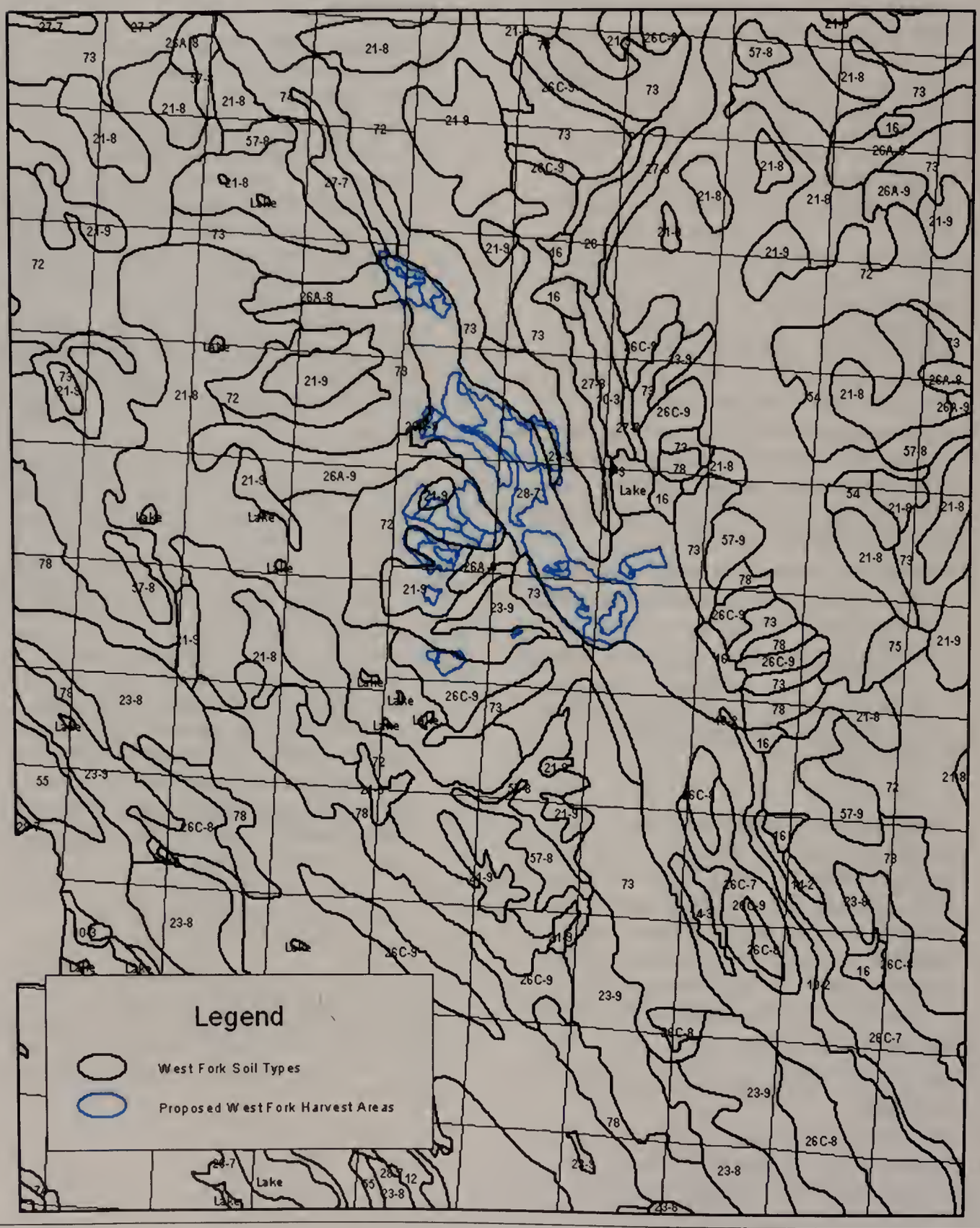


TABLE D-2 - SOIL MAP UNIT DESCRIPTIONS FOR THE WEST FORK TIMBER SALE PROJECT AREA

MAP UNIT	DESCRIPTION	SOIL DRAINAGE	ROAD LIMITATIONS	TOPSOIL DISPLACEMENT AND COMPACTION	SEEDLING ESTABLISHMENT	EROSION (BARE SURFACE)	NOTES
10-2	Alluvial soils	Poor to well drained	Moderate to severe	Severe	Good	Low	Streamside management guides will be applied.
14-3	Silty lacustrine terraces, 0-20% slopes	Somewhat poor	Poor bearing strength	Severe if wet	Good	High	Soil has very limited season of use; consider winter harvesting, designated skid trails. Roads may require turnpiking, special design, gravel. Lop and scatter, excavator pile, or broadcast burn slash.
21-8	Cirque basins, 20-40% slopes	Somewhat excessive	Moderate rock on ridges	Moderate	Fair, droughty	Moderate	Moderately deep coarse soils reduce water and nutrients. South slopes droughty. On slopes over 35%, lop and scatter, excavator pile, or broadcast burn slash.
21-9	Rock outcrops, shallow glacial till, 40-60% slopes	Moderate to well drained	Low/moderate	Moderate/ **high**	Poor	Moderate	Unsurfaced roads are very bumpy due to shallow bedrock. ***Displacement risk increases with slope. Avoid ground-based skidding on slopes over 45 percent.***
23-8	Glaciated mountain slopes, 20-40% slopes	Well drained	Low	Moderate/ high	Moderate competition	Moderate	Moderately deep coarse soils reduce water and nutrients. South slopes droughty. On slopes over 35%, lop and scatter, excavator pile, or broadcast burn slash.
23-9	Glaciated mountain slopes 40-60% slopes	Well drained	Low	Moderate/ high	Moderate competition	Moderate	Moderately deep coarse soils reduce water and nutrients. South slopes very droughty. Cable yard on slopes over 45% or soft-track up to 55% slopes.

MAP UNIT	DESCRIPTION	SOIL DRAINAGE	ROAD LIMITATIONS	TOPSOIL DISPLACEMENT AND COMPACTION	SEEDLLNG ESTABLISHMENT	EROSION (BARE SURFACE)	NOTES
26A-8	Glacial till, 20-40% slopes	Well drained	Moderate	Moderate	Good	Moderate	Deep productive soil. Fine-textured soil remains moist; check soil moisture. Topsoil depth is important.
26A-9	Glacial till, 20-40% slopes	Well drained	Moderate	Moderate	Good	Moderate	Deep productive soil. Fine-textured soil remains moist; check soil moisture. Topsoil depth is important.
26C-7	Glacial moraines, 0-20% slopes	Well drained	Low	Moderate (severe if wet)	Good	Low	Deep productive soil. Topsoil depth is important.
26C-8	Glacial moraines, 20-40% slopes	Well drained	Moderate/ high	Moderate/ high	Good	Moderate	Deep productive soil. Topsoil depth is important.
26C-9	Glacial moraines, 40-60% slopes	Well drained	Moderate/ high	Moderate/ high	Good	Moderate /high	Deep productive soil; average season of use. Limit soft-track skidder to slopes less than 45%.
27-7	Glacial dames and kettles, 10-20% slopes	Well drained	Low	Low	Fair	Moderate	Deep soil, low fertility. Topsoil depth is very important.
28-7	Glacial moraines, 0-20% slopes	Well drained	Low	Moderate	Moderate-droughty	Low	Topsoil depth is very important.
57-8	Residual soils, 20-40% slopes	Well drained	Low	Moderate	Fair, droughty	Moderate	Shallow and moderately deep very gravelly/rocky soils. Cable yarding on slopes over 45%, broadcast burn.

MAP UNIT	DESCRIPTION	SOIL DRAINAGE	ROAD LIMITATIONS	TOPSOIL DISPLACEMENT AND COMPACTION	SEEDLLNG ESTABLISHMENT	EROSION (BARE SURFACE)	NOTES
72	Glacial cirque wall, 60-90% slopes	Well drained	Rocky, steep	Low	Very poor	Low	Very shallow soils with excessively steep sideslopes. Cutslopes are difficult to revegetate.
73	Glacial trough wall, 60-90%	Well drained	Rocky, steep	Cable - moderate	Fair	High	Steep slopes, rocky soils with common rock outcrops. Cable logging recommended for slopes over 45%. Lop and scatter or excavator pile slash.
74	Stream breaklands, slopes over 60%	Fair to good, droughty on south slopes	Moderate to severe (steep)	High displacement	Fair, competition	High	Steep slopes require cable operation.

Appendix E

Fisheries Analysis

APPENDIX E
FISHERIES ANALYSIS

ISSUE

The purpose of this analysis is to assess potential impacts to cold-water fisheries within the West Fork Timber Sale Project area as a result of any one of the project alternatives.

INTRODUCTION

The West Fork Timber Sale Project area includes State trust lands within Sections 18, 19, 20, 28, 29, 30, 31, 32, 33, and 34, T34N, R23W, and Section 13, T34N, R24W, which lie entirely within the Swift Creek drainage (*5th code HUC 17010210050*). Up to 1,270 acres of total harvest area is proposed within the project area.

The project area includes the watersheds of 2 major tributaries of Swift Creek: West Fork of Swift Creek (West Fork) and East Fork of Swift Creek (East Fork). Additionally, 2 specific subbasins of the West Fork will be included in the analysis; from north to south, Stryker Creek and Johnson Creek. The downstream, main-stem reach of Swift Creek between Section 3, T33N, R23W, and Whitefish Lake is not within the project area and will not be included in this analysis. None of the project alternatives are expected to have any direct, indirect, or cumulative impacts with respect to downstream fisheries in the main-stem reach of Swift Creek.

The West Fork is identified on the Montana 303(d) list as an impaired stream, and a TMDL is scheduled for development in 2011. The portion of the West Fork within the project area has been identified as "not supporting" of cold-water fisheries and other aquatic life according to the 2002 and Draft 2004 303(d) lists developed by the DEQ. Probable causes of this listing include flow alteration, other habitat alterations, and siltation; the probable sources include silviculture, highway maintenance, and runoff.

The East Fork is identified on the Montana 303(d) list, but is not scheduled for TMDL development as an impaired stream. The portion of the East Fork within the project area has been identified as "partially supporting" cold-water fisheries and other aquatic life according to the 2002 and draft 2004 303(d) lists developed by DEQ. Probable causes of this listing include flow alteration and other habitat alterations; the probable sources include silviculture, habitat modification (other than hydromodification), and modification/destablilization of banks or shoreline.

The Swift Creek drainage, including the West Fork, East Fork, and any contributing subbasins, is classified as A-1 in the Montana Surface Water Quality Standards. The A-1 classification is for multiple beneficial-use waters, including the growth and propagation of cold-water fisheries and associated aquatic life. Among other criteria for A-1 waters, a 1 degree Fahrenheit maximum increase above naturally occurring water temperature is allowed within the range of 32 to 66 degrees Fahrenheit (0 to 18.9 degrees Celsius) and no increases are allowed above naturally occurring concentrations of sediment, which will harm or prove detrimental to fish or wildlife. In regard to sediment, naturally occurring includes conditions or materials present from runoff on developed land where all reasonable land, soil, and water conservation practices have been

applied. Reasonable practices include methods, measures, or practices that protect present and reasonably anticipated beneficial uses. The State has adopted Forestry BMPs through its Nonpoint-Source Management Plan as the principle means of controlling nonpoint-source pollution from silvicultural activities (*Thomas et al 1990*).

SPECIES

Native cold-water fish species within the project area include bull trout (*Salvelinus confluentus*), westslope cutthroat trout (*Oncorhynchus clarki lewisi*), slimy sculpin (*Cottus cognatus*), largescale sucker (*Catostomus macrocheilus*), and longnose sucker (*Catostomus catostomus*). The 1 nonnative species known to persist within the specific project area is eastern brook trout (*Salvelinus fontinalis*).

Neither slimy sculpin, largescale sucker, nor longnose sucker are identified as endangered, threatened, or sensitive species (*Montana Natural Heritage Program [MNHP] 2003*). Although all 3 species are an integral component of the aquatic ecosystem within the project area, any foreseeable issues or concerns regarding these species' populations or habitats can be addressed through an effects analysis for bull trout and westslope cutthroat trout. Eastern brook trout is an invasive species that is not a component of the region's historical biodiversity, but any foreseeable issues or concerns regarding this species' populations or habitats can also be addressed through an effects analysis for bull trout and westslope cutthroat trout.

Bull trout and westslope cutthroat trout are the primary cold-water species that will be addressed in this analysis. The U.S. Fish and Wildlife Service (USFWS) has listed bull trout as "threatened" under the Endangered Species Act. Both bull trout and westslope cutthroat trout are listed as Class-A Montana Animal Species of Concern. A Class-A designation is defined as a species or subspecies that has limited numbers and/or habitats both in Montana and elsewhere in North America and elimination from Montana would be a significant loss to the gene pool of the species or subspecies (*DFWP, MNHP, and Montana Chapter American Fisheries Society Rankings*). DNRC has also identified bull trout and westslope cutthroat trout as sensitive species (*ARM 36.11.436*).

Both bull trout and westslope cutthroat trout exhibit resident, fluvial, and adfluvial life forms. Resident life forms spend their juvenile and adult life in natal or nearby low-order tributaries. Fluvial and adfluvial life forms generally leave their natal streams within 1 to 3 years of emergence (*Shepard et al 1984, Fraley and Shepard 1989*) to mature in downstream river and lake systems, respectively, and then return again to headwater or upstream reaches to spawn. Fluvial and adfluvial life forms of bull trout and westslope cutthroat trout are typically larger than resident fish, and bull trout have been observed returning to upstream reaches during successive or alternating years to spawn (*Fraley and Shepard 1989*). The life forms and stages of bull trout and westslope cutthroat trout have evolved to coexist in overlapping geographic areas (*Nakano et al 1992, Pratt 1984, Shepard et al 1984*).

Fluvial and adfluvial bull trout generally mature between ages 5 to 6, begin upstream spawning migrations in April, and spawn between September and October in response to a temperature regime decline below 9 to 10 degrees Celsius (*Fraley and Shepard 1989*). Spawning adult bull trout are known to construct redds in close association with upwelling

groundwater and proximity to overhanging or instream cover (*Fraley and Shepard 1989*). Naturally occurring stream temperature regimes and substrate compositions having low levels of fine material are closely related to bull trout embryo and juvenile survival (*MBTSG 1998, Weaver and Fraley 1991, Pratt 1984*).

Resident westslope cutthroat trout have been observed maturing at ages 3 to 5 (*Downs et al 1997*), and all life forms are known to spawn during May through June (*Shepard et al 1984*). Naturally occurring stream-temperature regimes and substrate compositions having low levels of fine material are closely related to westslope cutthroat trout embryo and juvenile survival (*Pratt 1984*).

ISSUES RAISED DURING SCOPING

Four concerns were received by DNRC during the scoping process that pertain specifically to fisheries:

1) The project should protect the genetic diversity of existing bull trout populations.
2) The project should help protect bull trout and westslope cutthroat trout in Johnson and Swift creeks.
3) The project will not address existing areas of degraded habitat.
4) The project may further degrade bull trout habitat.

Concerns 1 and 2 are stated as conservation goals and are not considered 'issues' to be described in the *EXISTING CONDITIONS* and *ENVIRONMENTAL EFFECTS* sections. Concern 3 is an 'issue' that will be addressed under the *EXISTING CONDITIONS* habitat subissues for each basin and subbasin. Concern 4 is an 'issue' that will be addressed under the *ALTERNATIVE EFFECTS* habitat subissues for each basin and subbasin.

ANALYSIS METHODS AND SUBISSUES

The existing conditions of bull trout and westslope cutthroat trout populations and habitat will be described in the *EXISTING CONDITIONS* portion of this analysis. In *ALTERNATIVE EFFECTS*, those existing conditions will then be compared to the anticipated effects of the project alternatives to determine foreseeable impacts to bull trout and westslope cutthroat trout.

Analysis methods are a function of the types and quality of data available for analysis, which varies among the different basins and subbasins in the project area. The analyses may either be quantitative or qualitative. The best available data for both populations and habitats will be presented separately for Stryker and Johnson creeks and the West Fork. Existing conditions and foreseeable environmental effects for each subbasin will be explored using the following outline of subissues:

- Populations
  - presence
  - genetics
- Habitat
  - flow regime
  - sediment
  - channel form
  - large woody debris
  - riparian zone
  - stream temperature
  - connectivity

The East Fork will not be analyzed for existing conditions under the *EXISTING CONDITIONS* or *ALTERNATIVE EFFECTS* sections since a portion of Harvest Area II-A (see *Action Alternatives B* and *C*) is the only area within the East Fork watershed that is proposed for harvesting. This specific proposed harvest area includes approximately 31.5 acres within the East Fork watershed and lies on a very low slope, 1 to 2 percent gradient terrain. The boundary of the proposed harvest unit parallels the East Fork for

approximately 1,025 feet, but the boundary is at least 285 feet from the stream at all points. The very low relative amount of potential timber harvesting in the East Fork watershed and the associated risk of cumulative effects due to a potential water-yield increase is inconsequential (see *APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS*). Consequently, this stream will not be included in the fisheries analysis since no foreseeable direct, indirect, and/or cumulative impacts to bull trout or westslope cutthroat trout populations (presence, genetics) or habitat (flow regime, sediment, channel form, large woody debris, riparian zone, stream temperature, connectivity) are expected as a result of No-Action Alternative A or Action Alternatives B or C.

SUMMARY OF ALTERNATIVES

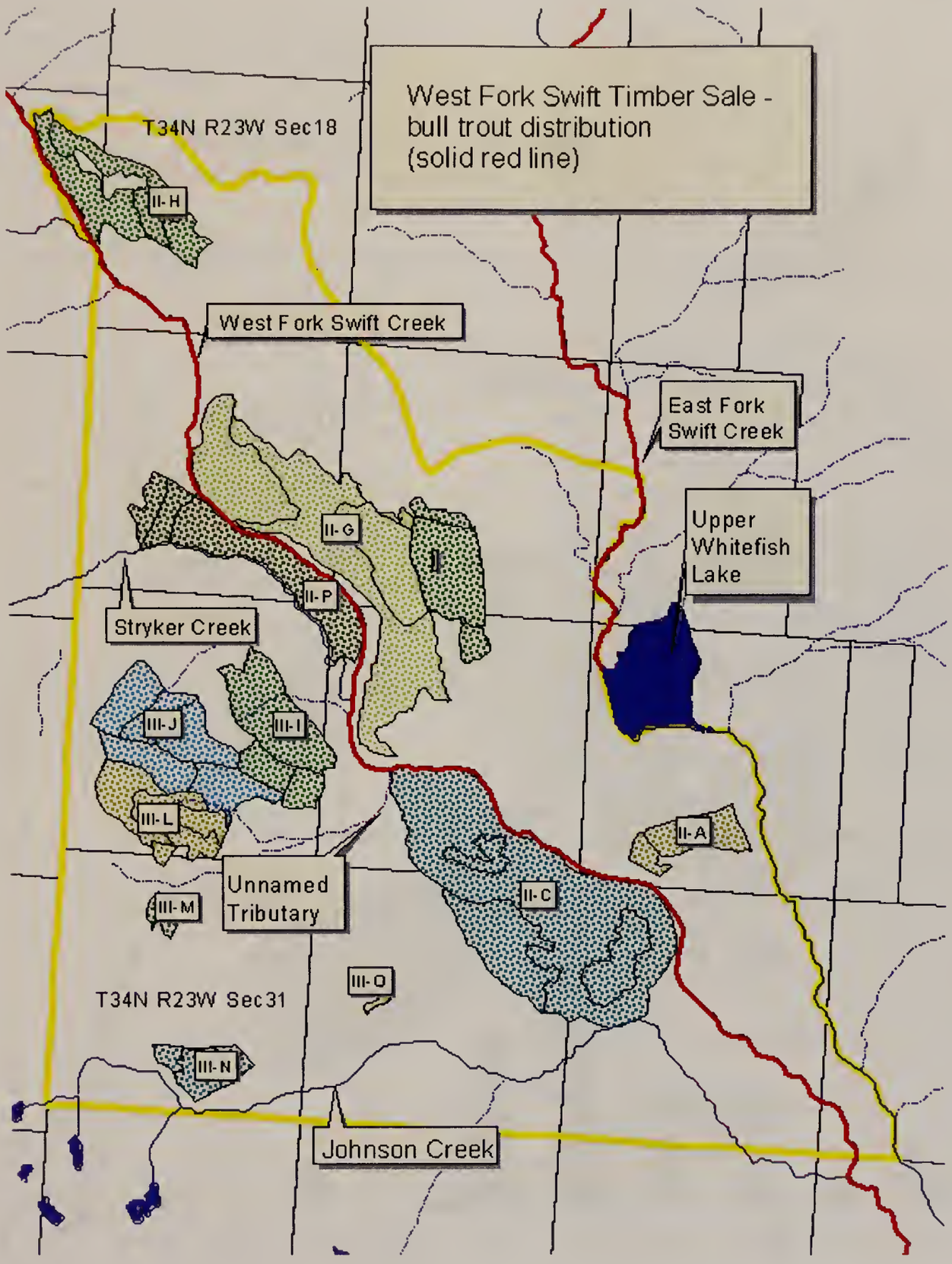
See *CHAPTER II—ALTERNATIVES* for detailed information, specific mitigations, and road management plans pertaining to No-Action Alternative A and Action Alternatives B and C.

Under No-Action Alternative A, existing conditions relative to bull trout and westslope cutthroat trout in the project area would remain unchanged as a result of the selection of this alternative.

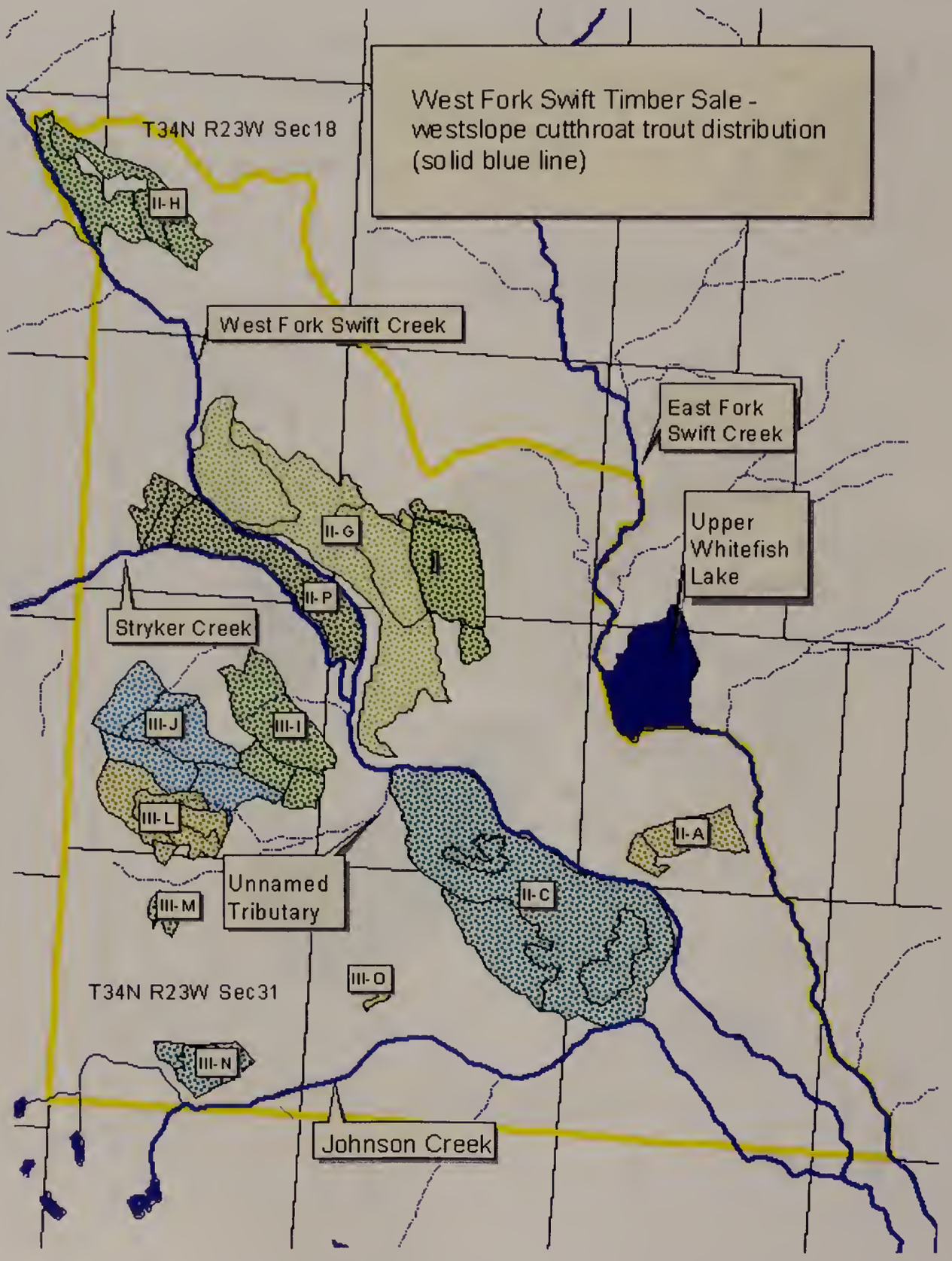
Action Alternative B involves 12 proposed timber harvest subareas in 3 areas; approximately 1,270 acres would be harvested using various silviculture plans. Actions associated with Action Alternative B would occur in the West Fork basin and the subbasins of Stryker Creek, and Johnson Creek, all of which provide varying degrees of bull trout and westslope cutthroat trout habitat.

Action Alternative C involves 6 proposed timber harvest subareas in 2 areas. Approximately 938 acres would be harvested using various silviculture plans. Actions associated with this alternative would occur in the West Fork basin and the subbasins of Stryker Creek, and Johnson Creek, all of which provide varying degrees of bull trout and westslope cutthroat trout habitat.

MAP 1 - KNOWN BULL TROUT DISTRIBUTION WITHIN THE PROJECT AREA (MFISH)



MAP 2 - *KNOWN WESTSLOPE CUTTHROAT TROUT DISTRIBUTION WITHIN THE PROJECT AREA (MFISH)*



EXISTING CONDITIONS

➢ *WEST FORK*

The West Fork is a fourth-order stream; the entire reach within the project area is considered fish bearing.

West Fork Bull Trout and Westslope Cutthroat Trout Populations

- ***Presence***

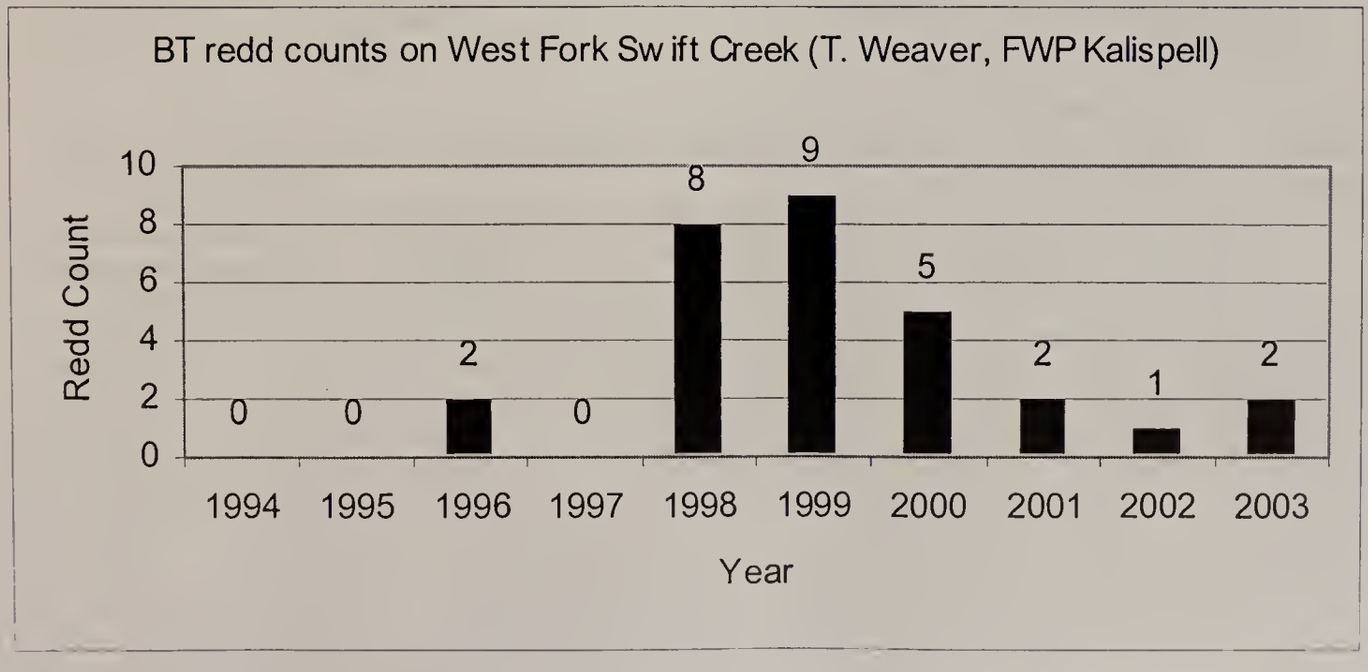
  The West Fork has been identified as ***providing important habitat for a disjunct bull trout population associated with Whitefish Lake.***

  Although bull trout may exhibit the resident life form in the West Fork, this subbasin is likely used by bull trout primarily as spawning and rearing habitat for disjunct populations associated with Whitefish and Upper Whitefish lakes. Genetic data suggests that migratory adults in the upper Flathead River system have been found to frequently return to their natal or near-natal streams (*Kanda et al 1997*), and populations of migratory spawning adult fish in the Flathead River system have been observed returning to the same stream reaches during subsequent spawning runs (*Fraley and Shepard 1989*). This propensity for habitual adult migration to natal or near-natal streams and the consequent selection of unique spawning locations would make the use of redd counts in the West Fork a valid measure of the trends of the species' overall success in occupying a specific subbasin.

  The protocol for collecting redd count and estimated population data in the West Fork is described in *Weaver and Fraley (1991)*. Experienced crews and fixed survey boundaries are used for result consistency.

  The data in *FIGURE E-1 - BULL TROUT REDD COUNTS IN WEST FORK OF SWIFT CREEK, 1994 THROUGH 2003* shows the number of bull trout redds constructed in the West Fork has ranged from 0 to 8 during the years 1994 to 2003. The data may also appear to describe a positive trend in bull trout success in the West

FIGURE E-1 - BULL TROUT REDD COUNTS IN WEST FORK OF SWIFT CREEK, 1994 THROUGH 2003



Fork, but the statistical significance of the simple linear regression is very low (r^2 = 0.0515), and studies suggest that a larger data set is needed in order to begin identifying long-term trends in bull trout populations through redd counts (*Rieman and Myers 1997*). The data in *TABLE E-1 - BULL TROUT POPULATION ESTIMATES IN THE WEST FORK, 1995 THROUGH 2003* shows the population estimates of bull trout age 1 and older in the West Fork has ranged from 0.22 to 5.10 individuals per 100 square meters during the years 1995 to 2003. The statistical significance of the simple linear regression for this data set is also very low (r^2 = 0.0022). For these reasons, it is determined that insufficient data is available to infer existing bull trout population trends or long-term success in the West Fork.

The West Fork is used primarily as habitat for resident westslope cutthroat trout, although resident adults typically spawn in several of the stream's lower-order tributaries such as Herrig, Stryker, and Johnson creeks. The West Fork may also be utilized to some degree as spawning and rearing habitat for adfluvial life forms that have matured in Whitefish or Upper Whitefish lakes. DFWP has conducted surveys of westslope cutthroat trout redd counts during the 2000, 2001, and 2002 early summer seasons utilizing the same protocols as described above for bull trout. No westslope cutthroat trout redds were counted during those survey years.

Due to lack of historic and comparable population presence data, there are no apparent existing direct and indirect impacts to bull trout and westslope cutthroat trout population presence in the West Fork.

- ***Genetics***

  Site-specific information from DFWP regarding bull trout genetics is unavailable. However, some level of hybridization has possibly occurred with resident or migratory eastern brook trout in the West Fork subbasin, as data suggests that this hybridization has occurred widely throughout the Flathead River basin (*Kanda et al 1997*). Any existing impact to bull trout populations in the subbasin as a result of hybridization with eastern brook

TABLE E-1 - BULL TROUT POPULATION ESTIMATES IN WEST FORK SWIFT CREEK, 1995 THROUGH 2003

DATE	POPULATION ESTIMATES	95-PERCENT CONFIDENCE INTERVAL	PROBABILITY OF FIRST-PASS CAPTURE	DENSITY (NUMBER PER 100 SQUARE METERS)
8/24/1995	9	no estimate		1.04
9/16/1996	7	no estimate		0.81
8/26/1997	8	no estimate		0.92
8/26/1998	44	+/-20	0.52	5.10
8/25/1999	14	+/-1	0.92	1.44
9/07/2000	9	+/-1	0.88	1.52
8/31/2001	29	+/-3	0.83	2.80
9/19/2002	12	+/-2	0.80	1.38
8/29/2003	2	no estimate		0.22

Data adapted from T. Weaver (fisheries biologist), DFWP, Kalispell: population estimates, 95-percent confidence intervals, probability of first-pass capture and densities for age 1 and older bull trout calculated from electrofishing in a 150-meter section of the West Fork.

trout most likely is low. Migratory bull trout tend to have a reproductive size advantage over resident eastern brook trout (*Reiman and McIntyre 1993*), and offspring can have a considerable chance of being sterile or exhibiting other progressive growth problems (*Leary et al 1983*).

A DFWP genetic survey in 1984 of 26 westslope cutthroat trout collected from the West Fork found the subspecies slightly introgressed with rainbow trout. The genetic purity of westslope cutthroat trout was determined at that time to be 97.4 percent (*MFISH 2004*).

Due to the possibility of bull trout and brook trout hybridization and the known occurrence of introgressed westslope cutthroat trout, there are existing low to moderate direct and indirect impacts to bull trout and westslope cutthroat trout population genetics in the West Fork.

West Fork Bull Trout and Westslope Cutthroat Trout Habitat

- ***Flow Regime***

  Flow regime is the range of discharge frequencies and intensities in a specific watershed that occur throughout the year. The analysis of hydrologic data for the West Fork basin indicates that the existing average flow regime for the stream is approximately 3.4 percent above the range of naturally occurring conditions (see *APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS*), which is primarily a result of past forest crown removal. The range of naturally occurring conditions is considered representative of those flow regimes in a fully forested, mature (20 to 30 years old) watershed.

  Changes in flow regime can affect bull trout and westslope cutthroat trout through modifications of stream morphology, sediment budget, streambank stability, and channel formations. There is likely no detectable existing impact on these specific habitat characteristics as a result of the estimated 3.4 percent increase in flow regime.

  Changes in flow regime have been known to affect bull trout and westslope cutthroat trout spawning migration, habitat available for spawning, and embryo survival; for this reason, there is a very low potential for direct and indirect impacts to bull trout and westslope cutthroat trout as a result of flow-regime modifications in the West Fork.

- ***Sediment***

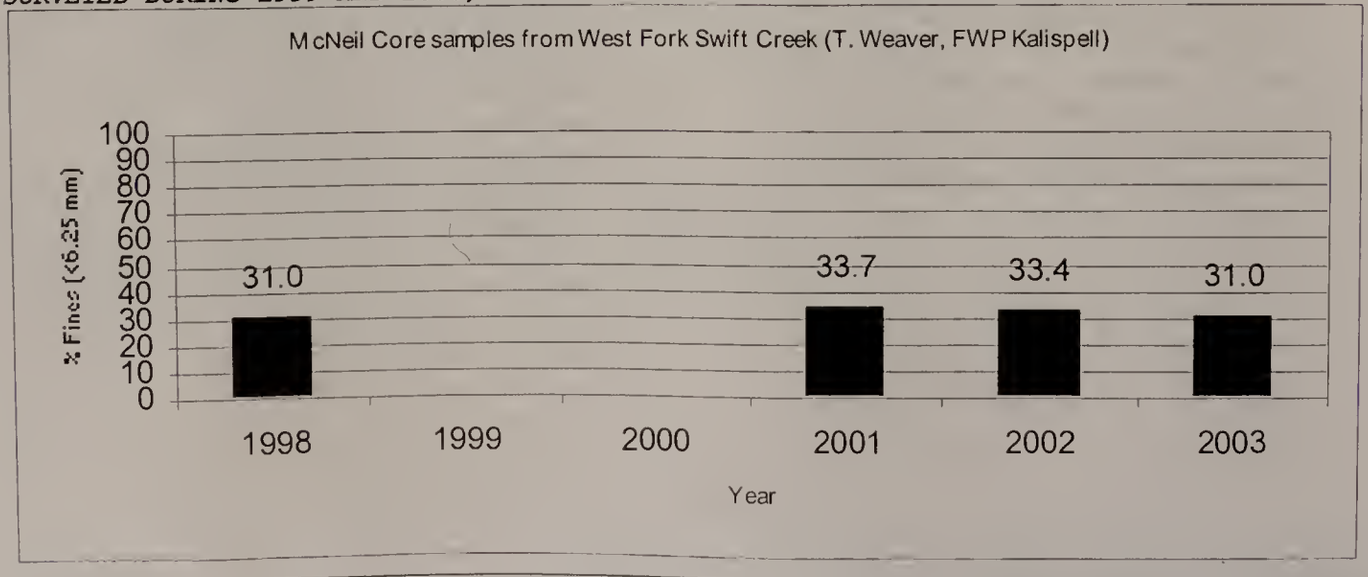
  Existing stream-sediment processes that are described in this analysis are *Rosgen* stream-morphological type, sediment budget, and streambank stability. The stream morphology of the West Fork, from the confluence with the East Fork (river mile 0.00) in Section 3, T33N, R23W, upstream through the project area and to a point (river mile 7.13) in Section 12, T34N, R24W, is generally described as exhibiting a B3/B4 *Rosgen* morphological type with gradients ranging from 2 to 4 percent (*Koopal 2001*). The B morphological type broadly includes riffle-dominated streams in narrow, gently sloping valleys, which typically exhibit infrequently spaced pools (*Rosgen 1996*). Furthermore, the B3/B4 morphological type is characteristic of channel compositions dominated by cobbles and codominated by

gravels, with lesser amounts of boulder, gravel, and sand (*Rosgen 1996*).

Several surveys have been conducted to describe the sediment budget of the West Fork, including McNeil core, substrate score, and Wolman pebble count. The McNeil core sampling methodology (*McNeil and Ahnell 1964*) has been demonstrated to be an effective technique for measuring temporal changes in the streambed permeability of spawning gravels. McNeil core data has been collected at known bull trout spawning reaches in the West Fork between 1998 and 2003 (*FIGURE E-2 - MCNEIL CORE SAMPLES FROM THE WEST FORK, 1998 THROUGH 2003 [NOT SURVEYED DURING 1999 AND 2000]*). *Weaver and Fraley (1991)* found that the percentage of substrates less than 6.35 millimeter in spawning beds was inversely proportional to bull trout and westslope cutthroat trout embryo survival in the Flathead River basin. The Flathead Basin Commission, a cooperative program involving private, State, and Federal landowners in the river basin, subsequently determined that streams with spawning gravels having 35 or 40 percent of substrates less than 6.35 millimeter in any given year were "threatened" or "impaired", respectively, in regards to bull trout and western cutthroat trout embryo survival (*Flathead Basin Commission 1991*). The McNeil core sample results from the West Fork are collected using *Weaver and Fraley (1991)* and are displayed in *FIGURE E-2 - MCNEIL CORE SAMPLES FROM THE WEST FORK, 1998 THROUGH 2003 [NOT SURVEYED DURING 1999 AND 2000]*) to show the proportion of substrates in the less than 6.35 millimeter size class. All of the sample sets show that the proportion of substrates less than 6.35 millimeters is under the 35 percent threshold for "threatened" status.

Embeddedness is generally described as the degree to which fine sediments surround coarse substrates on the streambed surface (*Sylte and Fischenich 2002*). The substrate score is one technique for measuring embeddedness, where higher scores indicate lower embeddedness and typically better juvenile bull trout habitat (*Shepard et al 1984*). A modified substrate score

FIGURE E-2 - MCNEIL CORE SAMPLES FROM THE WEST FORK, 1998 THROUGH 2003 (NOT SURVEYED DURING 1999 AND 2000)



methodology has been employed on the West Fork (*Weaver and Fraley 1991 citing others*) from 1994 through 2003 (see *FIGURE E-3 - SUBSTRATE SCORE SAMPLES FROM THE WEST FORK, 1994 THROUGH 2003 [NOT SURVEYED DURING 1995 AND 1998]*). The Flathead Basin Commission has subsequently determined that streams with substrate scores of 10 or 9 in any given year were "threatened" or "impaired", respectively, in regards to bull trout and westslope cutthroat trout embryo survival and juvenile rearing habitat (*Flathead Basin Commission 1991*). All of the sample sets in *FIGURE E-3 - SUBSTRATE SCORE SAMPLES FROM WEST FORK SWIFT CREEK, 1994 THROUGH 2003 (NOT SURVEYED DURING 1995 AND 1998)* show substrate scores higher than 10, and data also suggests that overall habitat quality as it relates to substrate embeddedness is likely improving over time.

The Wolman pebble count (*Wolman 1954*) is another method that can be used to describe temporal changes in substrate size classes on the streambed surface. Sample data from 2 collection sites on the West Fork is only available for the year 2001 (*FIGURE E-4 - WOLMAN PEBBLE COUNT RESULTS FROM THE WEST FORK, 2001*). The combined

FIGURE E-3 - SUBSTRATE SCORE SAMPLES FROM WEST FORK SWIFT CREEK, 1994 THROUGH 2003 (NOT SURVEYED DURING 1995 AND 1998)

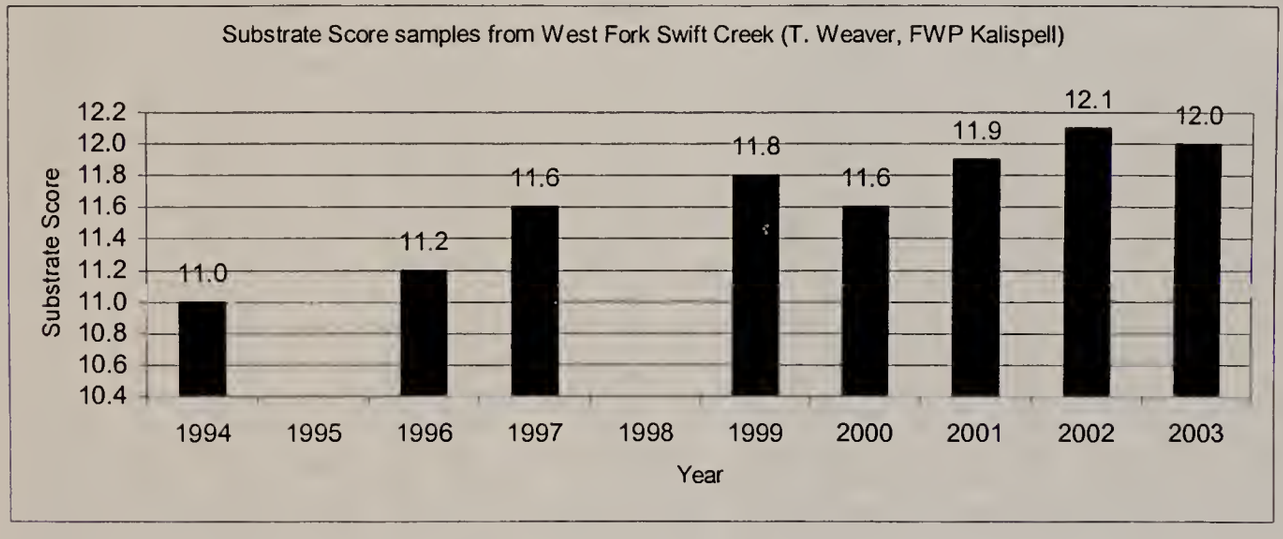
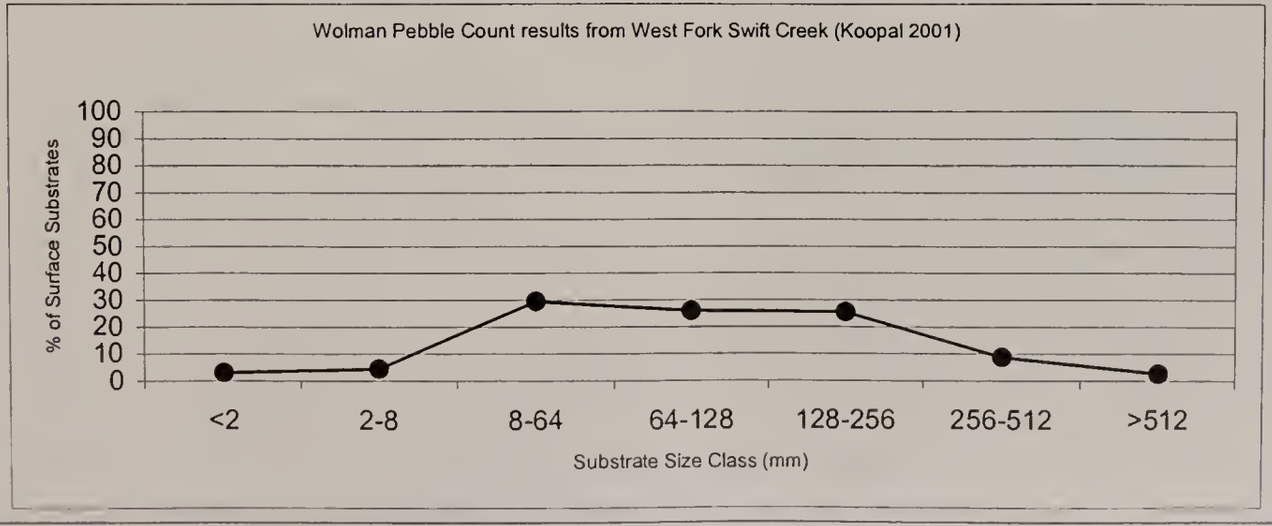


FIGURE E-4 - WOLMAN PEBBLE COUNT RESULTS FROM THE WEST FORK, 2001



percentage of substrates less than 8 millimeter is 7.5 percent, which is considerably lower than the results calculated for the similar size class in the McNeil core samples (percentage of substrate less than 6.35 millimeters ranges from 31.0 to 33.7 percent). This difference suggests that there could be a greater level of interstitial spaces in the streambed surface gravel and cobble substrates than may be indicated by the McNeil core data.

The final assessment of stream sediment processes includes a description of existing streambank stability. Streambank stability is a measure of bank erosion rates per stream length; temporal changes in the rates can be used as one indicator of potential existing impacts to fish habitats. Streambank stability data for the West Fork is only available for the year 2001 (*TABLE E-2 - STREAMBANK STABILITY RESULTS FROM THE WEST FORK (KOOPAL 2001)* and includes all stream habitats from the confluence with the East Fork (river mile 0.00) in Section 3, T33N, R23W, upstream through the project area and to a point

TABLE E-2 - STREAMBANK STABILITY RESULTS FROM THE WEST FORK (KOOPAL 2001)

HABITAT TYPE*	TOTAL NUMBER OF UNITS	TOTAL LEFT BANK LENGTH (FEET)	TOTAL RIGHT BANK LENGTH (FEET)	MEAN PERCENT STABLE BANK	MEAN PERCENT UNSTABLE BANK	MEAN PERCENT UNDERCUT BANK
DMV	1	49.0	49.0	100.00	0.00	15.00
DMW	5	215.0	214.0	86.60	13.40	0.70
GLD	2	220.0	220.0	100.00	0.00	0.00
HGR	7	831.0	832.0	100.00	0.00	0.26
LGR	140	29,135.0	29,303.0	99.26	0.74	1.09
RUN	27	2,714.0	2,704.0	100.00	0.00	2.09
SLB	6	178.0	178.0	100.00	0.00	2.30
SLM	27	999.0	1,003.0	100.00	0.00	7.09
SLW	22	595.0	591.0	94.18	5.82	2.76
SMB	12	476.0	486.0	100.00	0.00	2.35
SMW	10	324.0	329.0	99.17	0.83	6.26
SPB	2	71.0	75.0	100.00	0.00	3.08
SPW	38	1,016.0	1,011.0	97.83	2.17	5.01
STP	4	315.0	304.0	100.00	0.00	0.00
SUW	12	402.0	408.0	99.36	0.64	10.80
Totals	315	37,540.0	37,707.0			
Mean				99.19	0.81	1.61

**DMV = main channel dammed pool caused by beaver*
DMW = main channel dammed pool caused by large woody debris
GLD = glide, "HGR" = high gradient riffle
LGR = low gradient riffle
RUN = run
SLB = lateral scour pool formed by boulder
SLM = lateral scour pool formed by meander
SLW = lateral scour pool formed by large woody debris
SMB = mid-channel scour pool formed by boulder
SMW = mid-channel scour pool formed by large woody debris
SPB = plunge pool formed by boulder
SPW = plunge pool formed by large woody debris
STP = step-pool
SUW = underscour pool formed by large woody debris

(river mile 7.13) in Section 12, T34N, R24W. The protocol used for collecting the streambank stability data is outlined in *Overton et al (1997)*. Overall, the results of this data set show very high levels (99.19 percent) of streambank stability throughout the project area.

McNeil core data indicates that the substrates of known spawning reaches are not "threatened"; substrate scores describing streambed substrate embeddedness also indicate that known spawning reaches are not "threatened", and Wolman pebble counts suggest that there are high levels of streambed substrates in the gravel, cobble, and boulder classes. Additionally, a recent streambank-stability assessment shows very low levels of potential streambank erosion. Based on these observations, there are no existing direct and indirect impacts to bull trout and westslope cutthroat trout habitat as a result of sediment in the West Fork.

- ***Channel Forms***

  Two descriptions of channel formation will also be used to describe existing bull trout and westslope cutthroat trout habitat in the West Fork: *Montgomery/Buffington* classification (*Montgomery and Buffington 1997*) and *R1/R4 Fish Habitat Standard Inventory* (*Overton et al 1997*). The stream formations of the West Fork, from the confluence with the East Fork (river mile 0.00) in Section 3, T33N, R23W, upstream through the project area and to a point (river mile 7.13) in Section 12, T34N, R24W, are broadly described as exhibiting both 'pool-riffle' and 'forced pool-riffle' Montgomery/Buffington classifications. The 'forced pool-riffle' channel form is generally a function of large-woody-debris recruitment to the bankfull area of the stream, and both channel forms typically have pool frequencies of 1:5 to 1:7, where the later ratio is channel width (*Montgomery and Buffington 1997*).

  The *R1/R4 Fish Habitat Standard Inventory* is a useful protocol for describing existing conditions and tracking temporal changes in the relative proportions of different stream microhabitats used by bull trout, westslope cutthroat trout, and other native fisheries. Inventory data for the West Fork is only available for the year 2001 (*TABLE E-3 - R1/R4 FISH HABITAT STANDARD INVENTORY RESULTS FROM THE WEST FORK [KOOPAL 2001]*) and includes all stream habitats from the confluence with the East Fork (river mile 0.00) in Section 3, T33N, R23W, upstream through the project area and to a point (river mile 7.13) in Section 12, T34N, R24W.

  The *R1/R4 Fish Habitat Standard Inventory* data from 2001 indicates that 56 percent of all channel forms are nonpool features (GLD, HGR, LGR, RUN), and the remaining 44 percent of all channel forms are pool features. The relative numbers of nonpool and pool channel forms are roughly equivalent to the mean quantity of habitat area, which is 53 and 47 percent, respectively. On the contrary, the mean quantity of habitat volume in the West Fork is 43 percent for nonpool features and 57 percent for pool features. Increasing amounts of different pool habitats are typically proportional to increasing levels of bull trout and westslope cutthroat trout stream-habitat quality. As B morphological type streams are

TABLE E-3 - R1/R4 FISH HABITAT STANDARD INVENTORY RESULTS FROM THE WEST FORK SWIFT CREEK (KOOPAL 2001)

HABITAT TYPE*	TOTAL NUMBER OF UNITS	MEAN HABITAT LENGTH (FEET)	MEAN WIDTH (FEET)	MEAN HABITAT DEPTH (FEET)	MEAN WIDTH/DEPTH RATIO	MEAN HABITAT AREA (SQUARE FEET)	MEAN HABITAT VOLUME (CUBIC FEET)
DMV	1	49.0	19.5	0.68	28.68	955.5	649.7
DMW	5	41.4	18.7	0.76	24.90	772.2	586.0
GLD	2	110.0	13.7	0.52	32.55	1,509.0	777.6
HGR	7	118.4	14.1	0.54	27.91	1,669.2	894.5
LGR	140	208.0	17.2	0.52	35.94	3,568.7	1,873.5
RUN	27	107.5	17.1	0.65	29.37	1,838.0	1,194.2
SLB	6	29.3	16.4	0.79	20.91	479.7	377.8
SLM	27	36.5	16.0	0.83	21.07	584.7	483.6
SLW	22	26.0	17.9	0.84	24.45	465.6	393.3
SMB	12	39.6	17.8	0.77	24.17	702.6	539.0
SMW	10	31.8	19.5	0.72	29.70	620.6	447.4
SPB	2	35.5	12.6	0.76	16.62	446.8	340.2
SPW	38	26.1	18.1	0.89	22.56	471.8	418.6
STP	4	75.3	19.2	1.01	19.71	1,446.1	1,455.7
SUW	12	33.1	20.3	0.86	25.26	671.0	575.1
Total	315						
Mean		119.4	17.1	0.57	33.70	2,047.5	1,175.1

**DMV = main channel dammed pool caused by beaver*
DMW = main channel dammed pool caused by large woody debris
GLD = glide
HGR = high gradient riffle
LGR = low gradient riffle
RUN = run
SLB = lateral scour pool formed by boulder
SLM = lateral scour pool formed by meander
SLW = lateral scour pool formed by large woody debris
SMB = mid-channel scour pool formed by boulder
SMW = mid-channel scour pool formed by large woody debris
SPB = plunge pool formed by boulder
SPW = plunge pool formed by large woody debris
STP = step-pool
SUW = underscour pool formed by large woody debris

generally riffle dominated (*Rosgen 1996*), this data indicates that the West Fork likely provides an average quantity of pool habitat within the project area.

No specific conclusions regarding trends in channel form can be drawn from these current observations, but this data will be indispensable in future habitat assessment and monitoring efforts. Although insufficient data is available for describing existing trends in channel forms, likely there are no existing direct and indirect impacts to bull trout and westslope cutthroat trout habitat as a result of channel formations in the West Fork.

- ***Large Woody Debris***

  Large woody debris is recruited to the stream channel from adjacent and upstream riparian vegetation, and the material is a critical component in the formation of complex bull trout and westslope cutthroat trout habitat. All life stages of bull trout and westslope cutthroat trout have been observed closely associated with

TABLE E-4 - LARGE-WOODY-DEBRIS COUNT RESULTS FROM THE WEST FORK (KOOPAL 2001)

HABITAT TYPE*	TOTAL NUMBER OF UNITS	SINGLE PIECES			AGGREGATES				ROOT WADS		
		TOTAL NUMBER	MEAN NUMBER	NUMBER PER 100 FEET	TOTAL NUMBER	MEAN NUMBER	NUMBER PER 100 FEET	NUMBER OF PIECES	TOTAL NUMBER	MEAN NUMBER	NUMBER PER 100 FEET
DMV	1	1	1.0	2.0	0	0.0	0.0	0	0	0.0	0.0
DMW	5	1	0.2	0.5	6	1.2	2.9	47	0	0.0	0.0
GLD	2	2	1.0	0.9	0	0.0	0.0	0	0	0.0	0.0
HGR	7	12	1.7	1.4	6	0.9	0.7	16	0	0.0	0.0
LGR	140	368	2.6	1.3	223	1.6	0.8	707	14	0.1	0.0
RUN	27	33	1.2	1.1	25	0.9	0.9	77	1	0.0	0.0
SLB	6	5	0.8	2.8	2	0.3	1.1	10	0	0.0	0.0
SLM	27	24	0.9	2.4	10	0.4	1.0	41	6	0.2	0.6
SLW	22	3	0.1	0.5	20	0.9	3.5	94	2	0.1	0.3
SMB	12	11	0.9	2.3	8	0.7	1.7	32	1	0.1	0.2
SMW	10	2	0.2	0.6	10	1.0	3.1	59	1	0.1	0.3
SPB	2	2	1.0	2.8	2	1.0	2.8	7	0	0.0	0.0
SPW	38	23	0.6	2.3	29	0.8	2.9	161	0	0.0	0.0
STP	4	3	0.8	1.0	5	1.3	1.7	58	0	0.0	0.0
SUW	12	6	0.5	1.5	13	1.1	3.3	51	1	0.1	0.3
Totals	315	496			359			1,360	26		
Mean			1.6	1.3		1.1	1.0			0.1	0.1

**DM = main channel dammed pool caused by beaver*
DMW = main channel dammed pool caused by large woody debris
GLD = glide
HGR = high gradient riffle
LGR = low gradient riffle
RUN = run
SLB = lateral scour pool formed by boulder
SLM = lateral scour pool formed by meander
SLW = lateral scour pool formed by large woody debris
SMB = mid-channel scour pool formed by boulder
SMW = mid-channel scour pool formed by large woody debris
SPB = plunge pool formed by boulder
SPW = plunge pool formed by large woody debris
STP = step-pool
SUW = underscour pool formed by large woody debris

large woody debris in the Flathead River basin (*Platt 1984, Shepard et al 1984*). Large woody debris recruitment rates to the West Fork throughout the project area can be described using large-woody-debris counts per stream length; this data was collected during 2001 as part a *R1/R4 Fish Habitat Standard Inventory* (*Overton et al 1997*). (See *TABLE E-4 - LARGE-WOODY-DEBRIS COUNT RESULTS FROM THE WEST FORK [KOOPAL 2001]*). Large-woody-debris counts for the West Fork include all stream habitats from the confluence with the East Fork (river mile 0.00) in Section 3, T33N, R23W, upstream through the project area and to a point (river mile 7.13) in Section 12, T34N, R24W.

The mean large-woody-debris count per 1,000 feet is calculated by dividing the sum of the total number of single pieces, the number of pieces in each aggregate, and the total number of root wads by the total length of all main-channel habitat units (37,612.0 feet) surveyed during the inventory. The mean large-woody-debris count per 1,000 feet in the West Fork is 50 pieces per 1,000 feet.

Data from reference reaches (*Harrelson et al 1994*) in the Flathead River Basin region indicate that the average amount of large woody debris in undisturbed 'B' channel types (*Rosgen* morphological stream type) is 123 pieces per 1,000 feet plus or minus 57 percent (*Bower 2004*). This data suggests that existing amounts of large woody debris in the West Fork are below average when compared to reference reaches in the region with similar morphological characteristics.

Moderate levels of riparian harvests have occurred on the West Fork during the 1950s. These riparian harvests primarily involved the individual selection of larger diameter trees in the riparian zone throughout the existing project area and did not include clearcut methods in the riparian zone. This past individual-tree-selection harvest method likely reduced the amount of potentially recruitable large woody debris to the West Fork and could be associated with existing below-average amounts of large woody debris in the stream. Consequently, there is a low to moderate existing direct and indirect impact to bull trout and westslope cutthroat trout habitat as a result of low levels of large-woody-debris recruitment in the West Fork.

- ***Riparian Zone***

  The stream riparian area is broadly defined as the interface or linkage between the terrestrial and aquatic zones, and this area is critical for regulating large-woody-debris recruitment, thermal regimes, stream nutrient inputs, and water quality among other variables (*Hansen et al 1995*). This section will consider how riparian-zone function, in particular, is related to the potential for large-woody-debris recruitment. Studies of large-woody-debris recruitment to the stream channel suggest that the primary zone of recruitment is approximately equal to the height of the tallest trees growing in the riparian zone (*Robinson and Beschta 1990, Bilby and Bisson 1998*). The site-potential tree height at 100 years is used to estimate the extent of the primary zone of large-woody-debris recruitment for riparian areas adjacent to proposed harvest areas. Calculations of the site-potential tree height for riparian zones adjacent to various proposed harvest areas are displayed in *TABLE E-5 - CALCULATIONS OF SITE POTENTIAL TREE HEIGHT AT 100 YEARS**.

  As described in the previous section, *Large Woody Debris*, past individual-selection harvesting has likely reduced the amount of potentially recruitable large woody debris to the West Fork. This selective harvest is known to have occurred within those riparian zones delineated by the mean site-potential tree height at 100 years in *TABLE E-5 - CALCULATIONS OF SITE-POTENTIAL TREE HEIGHT AT 100 YEARS**. Consequently, there are low to moderate existing direct and indirect impacts to bull trout and westslope cutthroat trout habitat as a result of riparian-zone function in the West Fork.

*TABLE E-5 - CALCULATIONS OF SITE POTENTIAL TREE HEIGHT AT 100 YEARS**

AREA	ADJACENT STREAM	SAMPLE	SPECIES	HEIGHT (FEET)	AGE (YEARS)	SITE INDEX	SITE-POTENTIAL TREE HEIGHT AT 100 YEARS (FEET)	MEAN SITE-POTENTIAL TREE HEIGHT AT 100 YEARS (FEET)	REFERENCE
II-H	West Fork	1A-1	Englemann spruce	68	75	50	75		USFS INT-42
II-H	West Fork	1B-1	Englemann spruce	115	158	70	103		USFS INT-42
II-H	West Fork	1B-2	Englemann spruce	98	138	60	88		USFS INT-42
II-H	West Fork	2A-1	Subalpine fir	84	70	40	110		USFS RN-71
II-H	West Fork	2A-2	Englemann spruce	98	126	60	88		USFS INT-42
II-H	West Fork							**93**	
II-G	West Fork	3A-1	Subalpine fir	48	65	30	91		USFS RN-71
II-G	West Fork	3B-1	Englemann spruce	65	100	40	63		USFS INT-42
II-G	West Fork	3C-1	Englemann spruce	49	40	60	88		USFS INT-42
II-G	West Fork	3D-1	Subalpine fir	71	105	30	91		USFS RN-71
II-G	West Fork							**83**	
II-P	West Fork	5A-1	Subalpine fir	57	58	30	91		USFS RN-71
II-P	West Fork	5A-2	Englemann spruce	80	154	50	75		USFS INT-42
II-P	West Fork	5B-1	Subalpine fir	38	33	40	110		USFS RN-71
II-P	West Fork	5C-1	Englemann spruce	57	44	60	88		USFS INT-42
II-P	West Fork	5C-2	Subalpine fir	75	112	30	91		USFS RN-71
II-P	West Fork							**91**	
II-C	West Fork	7A-1	Subalpine fir	61	85	30	91		USFS RN-71
II-C	West Fork	7A-2	Englemann spruce	58	60	50	75		USFS INT-42
II-C	West Fork	7B-1	Englemann spruce	58	63	50	75		USFS INT-42
II-C	West Fork	7B-2	Englemann spruce	80	105	50	75		USFS INT-42
II-C	West Fork	7C-1	Subalpine fir	37	50	30	91		USFS RN-71
II-C	West Fork							**81**	

**Samples were taken by DNRC personnel on 3/3/2004 and 3/4/2004. Samples were taken from random trees with unimpeded growth at a distance of 50 feet from the bank-full slope break.*

- ***Stream Temperature***

  Stream temperature data for the West Fork, available for only 2001 and 2003, is displayed in *TABLE E-6 - STREAM TEMPERATURE DATA (CELCIUS) FOR THE WEST FORK**. The 'upper' recording station is located in the northwest quarter of Section 29, T34N, R23W, and the 'lower' recording station is located in the southwest quarter of Section 34, T34N, R23W. Data indicates that the annual mean weekly maximum temperature at the upper recording station is relatively stable (11.3 degrees Celsius during 2001 and 2003.) Data also indicates that the mean weekly maximum temperature at the lower recording station is more variable than the upper station (11.6 to 13.2 degrees Celsius during 2001 and 2003). During the 2 seasons of record, the average change in stream temperature through the lower half of the project area ranged from 0.3 to 1.9 degrees Celsius.

  In respect to bull trout, the temperature ranges described in *TABLE D-6 - STREAM TEMPERATURE DATA (CELCIUS) FOR THE WEST FORK** are at the upper end of the species' tolerances as observed in various studies. *Fraley and Shepard (1989)* rarely observed juvenile bull trout in streams exceeding 15 degrees Celsius. *Gamett (2002)* did not find bull trout where maximum stream temperatures exceeded 20 degrees Celsius. *Reiman and Chandler (1999)* found that bull trout are most frequently observed in streams having summer maximum temperatures of approximately 13 to 14 degrees Celsius.

  No specific conclusions regarding stream temperature trends in the West Fork can be drawn from these current observations, but this data will be indispensable in future habitat assessment and monitoring efforts. Although insufficient data is available for describing existing trends in stream temperature, no existing direct and indirect impacts to bull trout and westslope cutthroat trout habitat are likely as a result of stream temperature in the West Fork.

- ***Connectivity***

  Currently, 2 bridge crossings of the West Fork are in the project area in Sections 29 and 34, T34N, R23W. These crossings provide full passage of all life stages of bull trout and westslope cutthroat trout. No naturally occurring or manmade barriers to either trout exist on the West Fork in the project area.

TABLE E-6 - STREAM TEMPERATURE DATA (CELCIUS) FOR THE WEST FORK*

SITE NAME	SEASONAL MAXIMUM		SEASONAL MAXIMUM CHANGE IN TEMPERATURE		7-DAY AVERAGES		DAYS GREATER THAN 10.0 CELSIUS	DAYS GREATER THAN 15.0 CELSIUS
	DATE	VALUE	DATE	VALUE	DATE	MAXIMUM		
West Fork 2001 - Upper	08/07/01	11.8	07/07/01	6.4	08/09/01	11.3	36	0
West Fork 2001 - Lower	08/07/01	14.1	08/06/01	8.2	08/09/01	13.2	61	0
West Fork 2003 - Upper	07/23/03	11.7	07/18/03	5.9	07/22/03	11.3	35	0
West Fork 2003 - Lower	07/23/03	12.1	07/18/03	6.0	07/21/03	11.6	40	0

**Samples obtained by DNRC hydrologists using Stowaway (Onset Corporation) data loggers.*

There are no existing direct and indirect impacts to bull trout and westslope cutthroat trout habitat as a result of disconnectivity on the West Fork.

Summary of West Fork Existing Conditions

The entire West Fork watershed, including subbasins, has undergone extensive, but irregular timber harvesting through much of the past century, up to approximately 20 years ago. Existing, nonspecific pressures on bull trout and westslope cutthroat trout may include past upland or riparian timber harvesting and secondary road construction. The potential existing impacts from these past events may include increased sedimentation, increased peak flows, modifications of the hydrograph, and reduced large-woody-debris recruitment and channel stability (*Montana Bull Trout Scientific Group 1995, USFWS 2002b*). In the West Fork, an estimated 3 percent increase in the flow regime may be resulting in a modified hydrograph, and reduced large-woody-debris recruitment has been observed.

Moderate levels of riparian harvests have occurred on the West Fork during the 1950s. This riparian harvest primarily involved the individual selection of larger diameter trees in the riparian zone throughout the existing project area and did not include clearcut methods in the riparian zone. This past individual-selection harvest method likely reduced the amount of potentially recruitable large woody debris to the West Fork and could be associated with the existing below-average amounts of large woody debris in the stream (see *West Fork Bull Trout and Westslope Cutthroat Trout Habitat - Large Woody Debris*). This riparian canopy removal may also have led to temporarily increased stream temperatures as a result of increased incoming direct solar energy, but to accurately qualify the extent of this potential past impact is not possible. Nonetheless, this specific pattern of past riparian management collectively constitutes low past and present impacts to bull trout and westslope cutthroat trout in the West Fork.

No data is available regarding recreational fishing pressure on bull trout and westslope cutthroat trout in the West Fork (*MFISH 2004*); therefore, these potential past and present impacts are likely very low.

The existing road system in the project area has been assessed for specific sources of sedimentation to streams in the West Fork watershed. Estimates indicate that approximately 25.5 tons per year of road material (sediment) are contributed to streams in the West Fork watershed by the existing road system (see *APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS*).

Overall, low to moderate collective past and present impacts to bull trout and westslope cutthroat trout are likely in the West Fork as a result of the existing conditions described above.

➢ ***STRYKER CREEK***

Stryker Creek is a third-order stream and the entire reach within the project area is considered fish bearing.

Stryker Creek Bull Trout and Westslope Cutthroat Trout Populations

- **Presence**

  Very little fisheries data is available for Stryker Creek and no known fisheries surveys have been conducted on the creek. Although this subbasin is not typically utilized by bull trout

as spawning habitat for disjunct populations associated with Whitefish and Upper Whitefish lakes, a possibility exists that the lower reaches of the stream are utilized as short-term rearing habitat by juvenile bull trout that later become adfluvial or fluvial life forms. Also, the lower reaches of the stream could possibly be utilized to some degree by resident bull trout.

Westslope cutthroat trout are known to exist in Stryker Creek; however, the degree to which westslope cutthroat trout utilize the stream is not well studied. Stryker Creek most certainly provides some level of spawning and rearing habitat to resident westslope cutthroat trout and, possibly, adfluvial and fluvial life forms associated with Whitefish and Upper Whitefish lakes.

Due to the lack of historic and comparable population-presence data, there are no apparent existing direct and indirect impacts to bull trout and westslope cutthroat trout population presence in Stryker Creek.

- **Genetics**

  Information regarding the existing conditions of bull trout genetics in Stryker Creek is the same as that for the West Fork - see *West Fork Bull Trout and Western Cutthroat Trout Populations - Genetics)*.

  Site-specific information from DFWP regarding westslope cutthroat trout genetics in Stryker Creek is unavailable. A DFWP genetic survey in 1984 of 26 westslope cutthroat trout from the West Fork found the subspecies slightly introgressed with rainbow trout. The genetic purity of westslope cutthroat trout was determined at that time to be 97.4 percent (*MFISH 2004*). A possibility exists that genetic introgression among individual westslope cutthroat trout from the West Fork has spread upstream into Stryker Creek. Conversely, there is the possibility of a remnant population of westslope cutthroat trout in the upstream reaches of Stryker Creek that may be genetically pure.

  Due to the possibility of bull trout and brook trout hybridization and the occurrence of introgressed westslope cutthroat trout, existing low to moderate direct and indirect impacts to bull trout and westslope cutthroat trout population genetics in Stryker Creek are possible.

Stryker Creek Bull Trout and Westslope Cutthroat Trout Habitat

- **Flow Regime**

  Flow regime is the range of discharge frequencies and intensities in a specific watershed that occur throughout the year. The analysis of hydrologic data for the Stryker Creek subbasin indicates that the existing average flow regime for the stream is approximately 3.3 percent above the range of naturally occurring conditions, which is primarily a result of past forest crown removal. The range of naturally occurring conditions is considered representative of those flow regimes in a fully forested, mature (20 to 30 years old) watershed.

  Changes in flow regime can affect bull trout and westslope cutthroat trout through modifications of stream morphology, sediment budget, streambank stability, stream temperature ranges, and channel formations. There is likely no detectable existing impact on these specific habitat

characteristics as a result of the estimated 3.3 percent increase in flow regime.

Changes in flow regime have been know to affect bull trout and westslope cutthroat trout spawning migration, habitat available for spawning, and embryo survival; for this reason there is a very low potential for direct and indirect impacts to bull trout and westslope cutthroat trout as a result of flow-regime modifications in Stryker Creek.

- **Sediment**

  Field surveys of Stryker Creek within the project area have found the *Rosgen* stream morphological type to be B3; this is characteristic of cobble-dominated channels with lesser amounts of gravels, boulders, and sands (*Rosgen 1996*). Stream gradients range primarily from 4 to 6 percent. *Pfankuch (1978)* stream-stability scores from reaches within the project area range from 73 to 76, which is considered fair for B3 stream types.

  Based on these observations, existing direct and indirect impacts to bull trout and westslope cutthroat trout habitat are not likely as a result of sediment in Stryker Creek.

- **Channel Forms**

  Descriptions of channel formation that can be used to describe existing bull trout and westslope cutthroat trout habitat in Stryker Creek are the *Montgomery/Buffington* classification (*Montgomery and Buffington 1997*) and *R1/R4 Fish Habitat Standard Inventory* (*Overton et al 1997*). The stream formations of Stryker Creek, from the confluence with the West Fork (river mile 0.00) in Section 29, T34N, R23W, upstream through the project area and to a point (river mile 1.45) in Section 19, T34N, R24W, is broadly described as a transitional zone between 'forced pool-riffle' and 'plane-bed' classifications to 'forced step-pool' and 'step-pool' classifications, respectively. The 'forced pool-riffle' and 'forced step-pool' channel forms are generally a function of large-woody-debris recruitment to the bankfull area of the stream. The 'forced pool-riffle' channel form typically has pool frequencies of 1:5 to 1:7, where the later ratio is channel width, and gradients less than 3 percent (*Montgomery and Buffington 1997*). Both 'step-pool' channel forms typically have pool frequencies of 1:1 to 1:4, where the later ratio is channel width, and gradients of 3 to 8 percent (*Montgomery and Buffington 1997*). The 'plane bed' channel form typically does not have pools and generally occurs in gradients of 1 to 4 percent (*Montgomery and Buffington 1997*).

  R1/R4 Fish Habitat Standard Inventory (*Overton et al 1997*) is not available for Stryker Creek within the project area.

  Although insufficient data is available for describing existing trends in channel forms, no existing direct and indirect impacts to bull trout and westslope cutthroat trout habitat are likely as a result of channel formations in Stryker Creek.

- **Large Woody Debris**

  Large woody debris is recruited to the stream channel from adjacent and upstream riparian vegetation; this material is a critical component in the formation of complex bull trout and westslope cutthroat trout

habitat. All life stages of bull trout and westslope cutthroat trout have been observed closely associating with large woody debris in the Flathead River basin (*Platt 1984, Shepard et al 1984*). Large-woody-debris recruitment rates to Stryker Creek throughout the project area can be described using large-woody-debris counts per stream length; this data was collected during a survey in June 2004 using the protocol described in *Overton et al 1997*. Two separate 1,000-foot, large-woody-debris survey sections were located on Stryker Creek adjacent to proposed Harvest Area II-P; the mean large-woody-debris count per 1,000 feet in Stryker Creek was determined to be 131 pieces.

Data from reference reaches (*Harrelson et al 1994*) in the Flathead River basin region indicate that the average amount of large woody debris in undisturbed 'B' channel types (*Rosgen* morphological stream type) is 123 pieces per 1,000 feet, plus or minus 57 percent (*Bower 2004*). This data suggests that existing amounts of large woody debris in Stryker Creek are average when compared to reference reaches in the region with similar morphological characteristics.

Consequently, there are no direct and indirect impacts to bull trout and westslope cutthroat trout habitat as a result of large-woody-debris recruitment in Stryker Creek.

- **Riparian Zone**

  Proposed Harvest Area II-P is the only area immediately adjacent to Stryker Creek. The site-potential tree height in the riparian zone of this proposed harvest area was calculated for the West Fork. The watershed proximity and the similarity of stand types and growth conditions is sufficient enough that the site-potential tree-height values for the West Fork can be applied to Stryker Creek within proposed Harvest Area II-P. Therefore, the site-potential tree height at 100 years for this riparian zone is determined to be 91 feet (*TABLE E-5 - CALCULATIONS OF SITE-POTENTIAL TREE HEIGHT AT 100 YEARS*)*.

  There are no existing direct and indirect impacts to bull trout and westslope cutthroat trout habitat as a result of riparian-zone function adjacent to Stryker Creek.

- **Stream Temperature**

  Stream-temperature data is not available for Stryker Creek within the project area. Although Stryker Creek is quite similar to the West Fork in respect to many environmental conditions, stream temperature conditions and data generally can be moderately variable between subbasins.

  Although sufficient data is unavailable for describing existing trends in stream temperature, no existing direct and indirect impacts to bull trout and westslope cutthroat trout habitat are likely as a result of stream temperature in Stryker Creek.

- **Connectivity**

  Currently, 1 bridge crosses Stryker Creek in the northeast quarter of Section 30, T34N, R23W, of the project area. Although this bridge is a failing native-material structure, this crossing provides full passage of all life stages of bull trout and westslope cutthroat trout. No naturally occurring or manmade barriers to bull trout or westslope cutthroat trout are on

Stryker Creek in the project area.

There are no existing direct and indirect impacts to bull trout and westslope cutthroat trout habitat as a result of disconnectivity on Stryker Creek.

Summary of Stryker Creek Existing Conditions

The entire Stryker Creek watershed has undergone extensive, but irregular timber harvesting through much of the past century, up to approximately 20 years ago. Existing, nonspecific pressures on bull trout and westslope cutthroat trout may include past upland or riparian timber harvesting and secondary road construction. The potential existing impacts from these past events may include increased sedimentation, increased peak flows, modifications of the hydrograph, and reduced large-woody-debris recruitment and channel stability (*Montana Bull Trout Scientific Group 1995, USFWS 2002b*). In Stryker Creek, an estimated 3.3 percent increase in the flow regime may be resulting in a modified hydrograph.

No data is available regarding recreational fishing pressure on bull trout and westslope cutthroat trout in Stryker Creek (*MFISH 2004*); therefore, these potential past and present impacts are likely very low.

The existing road system in the project area has been assessed for specific sources of sedimentation to streams in the Stryker Creek watershed. Estimates indicate that approximately 2.8 tons per year of road material (sediment) are contributed to streams in the Stryker Creek watershed by the existing road system (see *APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS*).

Overall, low collective past and present impacts to bull trout and westslope cutthroat trout are likely in Stryker Creek as a result of the existing conditions described above.

➢ *JOHNSON CREEK*

Johnson Creek is a third-order stream and the entire reach within the project area is considered fish bearing. A variable portion of the lower reach immediately above the confluence with the West Fork exhibits discontinuous, subterrain flows during low-flow periods of the year.

Johnson Creek Bull Trout and Westslope Cutthroat Trout Populations

- **Presence**

  Limited fisheries data is available for Johnson Creek, and no known fisheries population surveys have been conducted on the stream. Although this subbasin is not likely utilized by bull trout as spawning habitat for disjunct populations associated with Whitefish and Upper Whitefish lakes, the lower perennial reaches of the stream are possibly utilized as short-term rearing habitat by juvenile bull trout that later become adfluvial or fluvial life forms. Also, the lower perennial reaches of the stream could possibly be utilized to some degree by resident bull trout.

  Westslope cutthroat trout are known to exist in Johnson Creek; however, the degree to which westslope cutthroat trout utilize the stream is not well studied. Johnson Creek most certainly provides some level of spawning and rearing habitat to resident westslope cutthroat trout and possibly adfluvial and fluvial life forms associated with Whitefish and Upper Whitefish lakes.

  Due to the lack of historic and comparable population-presence data, there are no apparent existing direct and indirect

impacts to bull trout and westslope cutthroat trout population presence in Johnson Creek.

- **Genetics**

  Information regarding the existing conditions of bull trout genetics in Johnson Creek is the same as that for the West Fork (see *West Fork Bull Trout and Westslope Cutthroat Trout Populations - Genetics*).

  A 1992 DFWP genetic survey of 52 westslope cutthroat trout from Johnson Creek (river mile 1.2 to 1.3) found the subspecies slightly introgressed with Yellowstone cutthroat trout. The genetic purity of westslope cutthroat trout was determined at that time to be 98.9 percent (*MFISH 2004*). A later (1998) DFWP genetic survey of 3 westslope cutthroat trout from an upstream reach of Johnson Creek (river mile 2.0 to 2.1) found samples to be genetically pure. The possibility exists that the genetic introgression that has occurred among the westslope cutthroat trout population within the reach of river mile 1.2 to 1.3 has since spread further upstream into Johnson Creek. Conversely, the possibility also exists that the population representing genetically pure specimens of westslope cutthroat trout in upstream reaches of Johnson Creek may remain genetically isolated.

  Due to the possibility of bull trout and brook trout hybridization and the known occurrence of introgressed westslope cutthroat trout, there are possible existing low to moderate direct and indirect impacts to bull trout and westslope cutthroat trout population genetics in Johnson Creek.

Johnson Creek Bull Trout and Westslope Cutthroat Trout Habitat

- **Flow Regime**

  Flow regime is the range of discharge frequencies and intensities in a specific watershed that occur throughout the year. The analysis of hydrologic data for the Johnson Creek subbasin indicates that the existing average flow regime for the stream is approximately 3.5 percent above the range of naturally occurring conditions (see *APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS*), which is primarily a result of past forest crown removal. The range of naturally occurring conditions is considered representative of those flow regimes in a fully forested, mature (20 to 30 years old) watershed.

  Changes in flow regime can affect bull trout and westslope cutthroat trout through modifications of stream morphology, sediment budget, streambank stability, stream temperature ranges, and channel formations. There is likely no detectable existing impact on these specific habitat characteristics as a result of the estimated 3.5 percent increase in flow regime.

  Changes in flow regime have been known to affect bull trout and westslope cutthroat spawning migration, habitat available for spawning, and embryo survival; for this reason, there is a very low potential for direct and indirect impacts to bull trout and westslope cutthroat trout as a result of flow regime modifications in Johnson Creek.

- **Sediment**

  Field surveys of the reach of Johnson Creek adjacent to proposed Harvest Area II-C and within the project area have

found the overall *Rosgen* stream morphological type to be B4; this is characteristic of gravel-dominated channels, with lesser amounts of cobbles, boulders, and sands (*Rosgen 1996*). The stream gradient in this reach is approximately 3 percent. The *Pfankuch (1978)* stream stability score for this reach is 79, which is considered fair for B4 stream types.

Based on these observations, no existing direct and indirect impacts to bull trout and westslope cutthroat trout habitat are likely as a result of sediment in Johnson Creek.

- **Channel Forms**

  Descriptions of channel formation that can be used to describe existing bull trout and westslope cutthroat trout habitat in Johnson Creek are the *Montgomery/Buffington* classification (*Montgomery and Buffington 1997*) and *R1/R4 Fish Habitat Standard Inventory* (*Overton et al 1997*). The stream formations of Johnson Creek, from the confluence with the West Fork (river mile 0.00) in Section 3, T33N, R23W, upstream through the project area and to a point (river mile 1.46) in the southwest quarter of Section 32, T34N, R23W, is broadly described as exhibiting both 'pool-riffle' and 'forced pool-riffle' *Montgomery/Buffington* classifications. The 'forced pool-riffle' channel form is generally a function of large-woody-debris recruitment to the bankfull area of the stream, and both channel forms typically have pool frequencies of 1:5 to 1:7, where the later ratio is channel width (*Montgomery and Buffington 1997*). The stream formations of Johnson Creek, from river mile 1.46 upstream through the project area and to a point (river mile 3.05) in Section 31, T34N, R23W, is broadly described as exhibiting 'step-pool', 'forced step-pool', and some 'cascade' *Montgomery/Buffington* classifications. Both 'step-pool' and 'forced step-pool' channel forms typically have pool frequencies of 1:1 to 1:4, where the later ratio is channel width, and gradients of 3 to 8 percent (*Montgomery and Buffington 1997*). The 'cascade' channel form typically has pool frequencies of 1:<1, where the later ratio is channel width, and gradients of 4 to 20 percent (*Montgomery and Buffington 1997*).

  R1/R4 Fish Habitat Standard Inventory (*Overton et al 1997*) is not available for Johnson Creek within the project area.

  Although sufficient data is unavailable for describing existing trends in channel forms, no existing direct and indirect impacts to bull trout and westslope cutthroat trout habitat are likely as a result of channel formations in Johnson Creek.

- **Large Woody Debris**

  Large-woody-debris count data is not available for Johnson Creek within the project area. Although Johnson Creek is a lower-order tributary to the West Fork, existing large-woody-debris counts within the project area are likely quite similar to those in the West Fork. This is probably attributed to watershed proximity, similar stand types and growth conditions, and similar soil and geologic conditions.

  Therefore, although sufficient data is unavailable to specifically describe existing conditions of large woody debris in Johnson Creek, low to

moderate existing direct and indirect impacts to bull trout and westslope cutthroat trout habitat are likely as a result of the low levels of large-woody-debris recruitment.

- **Riparian Zone**

  Proposed Harvest Area II-C is the only area immediately adjacent to Johnson Creek. Specific calculations of the site-potential tree height in the riparian zone adjacent to this proposed harvest area are not available. However, the site-potential tree height in the riparian zone of this proposed harvest area was calculated for the West Fork. There is sufficient watershed proximity and similarity of stand types and growth conditions that the site-potential tree-height values for the West Fork can be applied to Johnson Creek within proposed Harvest Area II-C. Therefore, the site-potential tree height at 100 years for this riparian zone is determined to be 81 feet (*TABLE E-5 - CALCULATIONS OF SITE-POTENTIAL TREE HEIGHT AT 100 YEARS**).

  There are likely no existing direct and indirect impacts to bull trout and westslope cutthroat trout habitat as a result of riparian-zone function adjacent to Johnson Creek.

- **Stream Temperature**

  Stream-temperature data is not available for Johnson Creek within the project area. Although Johnson Creek is quite similar to the West Fork in respect to many environmental conditions, stream temperature conditions and data generally can be moderately variable between subbasins.

  Although insufficient data is available for describing existing trends in stream temperature, no existing direct and indirect impacts to bull trout and westslope cutthroat trout habitat are likely as a result of stream temperature in Johnson Creek.

- **Connectivity**

  Currently 1 culvert crossing and 3 bridge crossings exist on Johnson Creek in the project area. The culvert is located in the southeast quarter of Section 33, T34N, R23W, and the bridges are located in the southeast quarter of Section 32, the southwest quarter of Section 32, and the southeast quarter of Section 31, all in T32N, R23W. The 3 bridge crossings provide full passage of all life stages of bull trout and westslope cutthroat trout.

  A variable portion of the lower reach immediately above the confluence with the West Fork exhibits discontinuous, subterrain flows during low-flow periods of the year. With discontinuous flow, this reach acts as a naturally occurring seasonal barrier to bull trout and westslope cutthroat trout migration. Bull trout and westslope cutthroat trout passage through this reach is most likely possible only during runoff or other bankfull flow events.

  The culvert on Johnson Creek within the project area is located on the lower reach with discontinuous flow. This culvert was surveyed during 2003 as part of the *DNRC Fish Passage Assessment Project*; information collected during that survey was used to model seasonal low and high flows, along with juvenile and adult cutthroat trout passage through the structure using *FishXing* software (*1999*). The results of those modeling efforts indicate that the culvert is an upstream migration

barrier to juveniles and most adult westslope cutthroat trout. Only those adults capable of attaining burst swim speeds of 9.75 feet per second for 7.5 seconds are likely able to migrate upstream through the culvert during low to bankfull flows. These results are likely representative of bull trout and westslope cutthroat trout swim performances and suggest that only a portion of the strongest swimming adults are able to migrate upstream through the structure.

Due to very limited upstream migration potential through the culvert located in the lower reach with seasonal, discontinuous flow, there is a moderate existing direct and indirect impact to bull trout and westslope cutthroat trout habitat as a result of disconnectivity on Johnson Creek.

Johnson Creek Existing Cumulative Impacts

The entire Johnson Creek watershed has undergone extensive, but irregular, timber harvesting through much of the past century, up to approximately 20 years ago. Existing, nonspecific pressures on bull trout and westslope cutthroat trout may include past upland or riparian timber harvesting and secondary road construction. The potential existing impacts from these past events may include increased sedimentation, increased peak flows, modifications of the hydrograph, and reduced large-woody-debris recruitment and channel stability (*Montana Bull Trout Scientific Group 1995, USFWS 2002b*).

Moderate levels of riparian harvesting have occurred on Johnson Creek during the previous harvest period described above. This riparian harvest primarily involved the individual selection of larger-diameter trees in the riparian zone throughout the existing project area and did not include clearcut methods in the riparian zone. This past individual-tree-selection harvest method likely reduced the amount of potentially recruitable large woody debris to Johnson Creek and could be associated with possible below-average amounts of large woody debris in the stream (see *West Fork Bull Trout and Westslope Cutthroat Trout Habitat - Large Woody Debris* under *Stryker Creek*). This riparian canopy removal may also have led to temporarily increased stream temperatures as a result of increased incoming direct solar energy, but to accurately qualify the extent of this potential past impact is not possible. Nonetheless, this specific pattern of past riparian management collectively constitutes low past and present impacts to bull trout and westslope cutthroat trout in Johnson Creek.

No data is available regarding recreational fishing pressure on bull trout and westslope cutthroat trout in Johnson Creek (*MFISH 2004*); therefore, potential past and present impacts are likely very low.

The existing road system in the project area has been assessed for specific sources of sedimentation to streams in the Johnson Creek watershed. Estimates indicate that approximately 5.2 tons per year of road material (sediment) are contributed to streams in the Johnson Creek watershed by the existing road system (see *APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS*).

Overall, low to moderate collective past and present impacts to bull trout and westslope cutthroat trout are likely in Johnson Creek as a result of the existing conditions described above.

ALTERNATIVE EFFECTS

DIRECT AND INDIRECT EFFECTS FOR THE WEST FORK, STRYKER CREEK, AND JOHNSON CREEK

Bull Trout and Westslope Cutthroat Trout Populations

~ *Presence*

- ***Direct and Indirect Effects of No-Action Alternative A***

  This no-action alternative would not be expected to have any direct or indirect impacts to bull trout and westslope cutthroat trout population presence in the West Fork or Stryker or Johnson creeks beyond those described under *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative B***

  The existing conditions describe confirmed bull trout and westslope cutthroat trout presence in the West Fork and Johnson Creek and the likely presence of one or both species in Stryker Creek. Redd count and estimated population data from the West Fork indicate that habitat utilization specific to this stream is variable for both bull trout and westslope cutthroat trout. It is reasonable to assume that relatively proportionate levels of variability in habitat utilization also occur in Stryker and Johnson creeks.

  Action Alternative B would not involve direct or indirect impacts to any specific bull trout or westslope cutthroat trout populations in the project area. Therefore, Action Alternative B would have no direct or indirect impact to bull trout and westslope cutthroat trout population presence in the West Fork or Stryker and Johnson creeks beyond those described under *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative C***

  Direct and indirect impacts to bull trout and westslope cutthroat trout population presence as a result of Action Alternative C are expected to be the same as those described for Action Alternative B.

~ *Genetics*

- ***Direct and Indirect Effects of No-Action Alternative A***

  No-Action Alternative A would not be expected to have any direct or indirect impacts to bull trout and westslope cutthroat trout population genetics in the West Fork or Stryker and Johnson creeks beyond those described under *Existing Conditions*.

- ***Direct and Indirect Effects of Action Alternative B***

  The eastern brook trout may negatively affect bull trout population genetics in the West Fork and Stryker and Johnson creeks through hybridization, as described in the *EXISTING CONDITIONS*. However, the introduction, migration, and spawning behavior of nonnative eastern brook trout and the consequent population biological interactions with bull trout are beyond the control and regulatory jurisdiction of DNRC land-management activities.

  Different strains of nonnative and historic hatchery rainbow trout may hybridize with westslope cutthroat trout, which can introduce long-term genetic introgression to pure westslope cutthroat trout populations in the West Fork and Stryker and Johnson creeks. The genetic introgression of westslope cutthroat trout may also arise from hybridization with Yellowstone cutthroat trout, through either local

introduction of the subspecies or residual introgression introduced by westslope cutthroat trout that may have originally come from historic cutthroat trout hatcheries. Introgression, in general, negatively affects genetically pure westslope cutthroat trout, and, as described in *EXISTING CONDITIONS*, this is known to have occurred at a minimum in the West Fork and Johnson Creek (*MFISH 2004*). However, the introduction, migration, and spawning behavior of nonnative rainbow trout and the consequent population biological interactions with westslope cutthroat trout are beyond the control and regulatory jurisdiction of DNRC land-management activities. Additionally, the genetic pathway within westslope cutthroat trout populations of genes specific to Yellowstone cutthroat trout is also beyond the control of DNRC land-management activities.

Therefore, Action Alternative B would not be expected to have any direct or indirect impacts to bull trout and westslope cutthroat trout population genetics in the West Fork or Stryker and Johnson creeks beyond those described under *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative C***

  Direct and indirect environmental effects of Action Alternative C to bull trout and westslope cutthroat trout population genetics would be expected to be the same as those described for Action Alternative B.

~ Flow Regime

- ***Direct and Indirect Effects of No-Action Alternative A***

  No-Action Alternative A would not be expected to have any direct or indirect impacts to the flow-regime component of bull trout and westslope cutthroat trout habitat in the West Fork or Stryker and Johnson creeks beyond those described under *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative B***

  Changes in flow regime can affect bull trout and westslope cutthroat trout spawning migration, spawning behavior, potential spawning habitat, and embryo survival through modifications of stream morphology, sediment budget, streambank stability, stream temperature ranges, and channel formations. An analysis of potential actions related to Action Alternative B indicates that water yields would increase from approximately 3.4 percent (existing conditions) to approximately 6.0 percent in the West Fork, approximately 3.3 percent (existing conditions) to approximately 4.1 percent in Stryker Creek, and approximately 3.5 percent (existing conditions) to approximately 3.9 percent in Johnson Creek (see *APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS*).

  The range of potential water-yield increases to streams with bull trout and westslope cutthroat trout habitat in the project area is approximately from 0.4 percent to 2.6 percent. With respect to those existing conditions described earlier, these potential modifications of flow regimes as a result of Action Alternative B are expected to have negligible, if any, direct and indirect impacts

to bull trout and westslope cutthroat trout in the West Fork and Stryker and Johnson creeks.

- ***Direct and Indirect Effects of Action Alternative C***

  Changes in flow regime can affect bull trout and westslope cutthroat trout spawning migration, spawning behavior, potential spawning habitat, and embryo survival through modifications of stream morphology, sediment budget, streambank stability, stream temperature ranges, and channel formations. An analysis of potential actions related to Action Alternative C indicate that water yields would increase from approximately 3.4 percent (existing conditions) to approximately 5.0 percent in the West Fork, approximately 3.3 percent (existing conditions) to approximately 3.5 percent in Stryker Creek, and approximately 3.5 percent (existing conditions) to approximately 3.7 percent in Johnson Creek (see *APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS*).

  The range of potential water yield increases to streams with bull trout and westslope cutthroat trout habitat in the project area is approximately 0.2 percent to approximately 1.6 percent. With respect to those existing conditions described earlier, these potential modifications of flow regimes as a result of Action Alternative C are expected to have negligible, if any, direct and indirect impacts to bull trout and westslope cutthroat trout in the West Fork and Stryker and Johnson creeks.

Bull Trout and Westslope Cutthroat Trout Habitat

~ **Sediment**

- ***Direct and Indirect Effects of No-Action Alternative A***

  No-Action Alternative A would not be expected to have any direct or indirect impacts to the sediment component of bull trout and westslope cutthroat trout habitat in the West Fork or Stryker and Johnson creeks beyond those described under *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative B***

  Modifications of stream sediment size classes, especially with trends toward fine size classes, could adversely affect bull trout and westslope cutthroat trout in the project area by reducing the quality of spawning habitat, in-stream cover, rearing habitat, and wintering habitat. Increased levels of fine sediments can be introduced to the stream system from various sources, including bank erosion due to stream channel instability, road features, and adjacent timber-harvesting operations.

  Data from *APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS* in this EIS indicates that the range of potential water-yield increases as a result of Action Alternative B is generally insufficient to facilitate the development of unstable stream channels.

  APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS also indicates that road improvements associated with Action Alternative B would reduce sedimentation to the West Fork and Stryker Creek by approximately 4.2 tons per year and by approximately 2.7 tons per year to Johnson Creek. Road

improvement activities that remove or mitigate potential sediment sources may have temporary, unavoidable, and short-term impacts to the sediment component of streams (see *APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS*), which may correspond to a minor, short-term impact to bull trout or westslope cutthroat trout. However, these road improvements would provide a long-term, net-positive impact to bull trout and westslope cutthroat trout habitat in respect to sediment.

Timber harvesting operations adjacent to the West Fork and Stryker and Johnson creeks would comply with SMZ laws. The SMZ laws are designed to provide adequate mitigations for the prevention of sedimentation to streams from adjacent timber-harvest-related activities.

With respect to those existing conditions described earlier, the selection of Action Alternative B would likely provide net-positive direct and indirect impacts to the sediment component of bull trout and westslope cutthroat trout habitat in the West Fork and Stryker and Johnson creeks.

- ***Direct and Indirect Effects of Action Alternative C***

  Modifications of stream-sediment size classes, especially with trends toward fine size classes, could adversely affect bull trout and westslope cutthroat trout in the project area by reducing the quality of spawning habitat, in-stream cover, rearing habitat, and wintering habitat. Increased levels of fine sediments can be introduced to the stream system from various sources, including bank erosion due to stream channel instability, road features, and adjacent timber-harvesting operations.

  Data from *APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS* indicates that the range of potential water-yield increases as a result of Action Alternative C is generally insufficient to facilitate the development of unstable stream channels.

  The *APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS* also indicates that road improvements associated with Action Alternative C would reduce sedimentation to the West Fork and Stryker Creek by approximately 2.6 tons per year and by approximately 0.0 tons per year to Johnson Creek. Road-improvement activities that remove or mitigate potential sediment sources may have temporary, unavoidable, and short-term impacts to the sediment component of streams (see *APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS*), which may correspond to a minor, short-term impact to bull trout or westslope cutthroat trout. However, these road improvements would provide a long-term, net-positive impact to bull trout and westslope cutthroat trout habitat in respect to sediment.

  Timber-harvesting operations adjacent to the West Fork and Stryker and Johnson creeks would comply with SMZ laws. The SMZ laws are designed to provide adequate mitigations for the prevention of sedimentation to streams from adjacent activities related to timber harvesting.

  With respect to those existing conditions described earlier, the selection of Action Alternative C would likely provide net-positive direct and indirect impacts to the sediment component of bull trout and westslope cutthroat trout habitat in the West Fork and Stryker and Johnson creeks.

~ Channel Forms

- ***Direct and Indirect Effects of No-Action Alternative A***

  No-Action Alternative A would not be expected to have any direct or indirect impacts to the channel-form component of bull trout and westslope cutthroat trout habitat in the West Fork and Stryker and Johnson creeks beyond those described under *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative B***

  Potential changes to stream channel forms are primarily a function of modifications to flow regimes and consequent relationships with existing sediment size classes. As indicated earlier, modifications to the bull trout and westslope cutthroat trout habitat features of flow regime and sediment as a result of Action Alternative B are expected to be negligible or not occur at all.

  Therefore, with respect to those existing conditions described earlier, there are no foreseeable direct and indirect impacts to the channel form component of bull trout and westslope cutthroat trout habitat in the West Fork and Stryker and Johnson creeks.

- ***Direct and Indirect Effects of Action Alternative C***

  Potential changes to stream channel forms are primarily a function of modifications to flow regimes and consequent relationships with existing sediment size classes. As indicated earlier, modifications to the bull trout and westslope cutthroat trout habitat features of flow regime and sediment as a result of Action Alternative C are expected to be negligible or not occur at all.

  Therefore, with respect to those existing conditions described earlier, there are no foreseeable direct and indirect impacts to the channel form component of bull trout and westslope cutthroat trout habitat in the West Fork and Stryker and Johnson creeks.

~ Large Woody Debris

- ***Direct and Indirect Effects of No-Action Alternative A***

  No-Action Alternative A would not be expected to have any direct or indirect impacts to the large-woody-debris component of bull trout and westslope cutthroat trout habitat in the West Fork or Stryker and Johnson creeks beyond those described under *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative B***

  Action Alternative B proposes varying levels of timber harvesting up to, but not within, 100 feet of the nearest stream bankfull edges of the West Fork (proposed Harvest Areas II-H, II-G, II-P, and II-C), Stryker Creek (proposed Harvest Area II-P), and Johnson Creek (proposed Harvest Area II-C). Potential large-woody-debris recruitment to the channels of these and other streams is a function of the distance from the stream channel that riparian trees may fall in order to contribute large woody debris. This distance from the stream channel is generally equal to the mean height of dominant and co-dominant trees (*Robinson and Beschta 1990, Bilby and Bisson 1998*), which is usually expressed as the site-potential tree height.

  As described in *EXISTING CONDITIONS*, the site-potential tree height at 100 years from sample sites in the riparian zone along both sides of the

West Fork throughout the project area ranges from 81 to 93 feet. The riparian zones along Stryker and Johnson creeks are likely sufficiently similar to those in the West Fork that site-potential tree heights of 81 to 93 feet can also be applied to these areas. Since a no-harvest buffer of 100 feet would be established between the 3 streams and associated proposed harvest areas described above, rates of potential large-woody-debris recruitment to any of these 3 stream channels is not expected to be affected by any of the proposed harvest areas. Correspondingly, a study of large-woody-debris recruitment to stream channels in Alaska found that 99 percent of in-stream large woody debris was recruited from trees within 30 meters (96 feet) of the stream channel (*Murphy and Koski 1989*).

In-stream large woody debris may also be recruited to 1 of the 3 stream channels from upstream channel reaches. Proposed Harvest Area III-I intersects 1 intermittent stream channel that eventually delivers seasonal flow to the West Fork, and proposed Harvest Areas III-J and III-L are jointly bordered by 1 intermittent stream channel that eventually delivers seasonal flow to the West Fork. The very low discharge of these 2 intermittent streams is unlikely to provide sufficient energy for transportation of large woody debris to downstream reaches. The intersecting reaches of these 2 first-order, intermittent tributaries, which would also have established buffers for Class I streams according to *Streamside Management Rules (1996)*, are not expected to affect sources of upstream large-woody-debris recruitment to the West Fork in any measurable or detectable way.

Therefore, Action Alternative B would not be expected to have any direct or indirect impacts to the large-woody-debris component of bull trout and westslope cutthroat trout habitat in the West Fork or Stryker and Johnson creeks beyond those described under *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative C***

  Although Action Alternative C does not propose any harvesting in Harvest Area III, the consequences, in respect to large woody debris, would be identical to those of Action Alternative B. Therefore, the direct and indirect effects of Action Alternative C to the large-woody-debris component of bull trout and westslope cutthroat trout habitat would be expected to be the same as those described for Action Alternative B.

~ **Riparian Zone**

- ***Direct and Indirect Effects of No-Action Alternative A***

  No-Action Alternative A would not be expected to have any direct or indirect impacts to the riparian-zone component of bull trout and westslope cutthroat trout habitat in the West Fork or Stryker or Johnson creeks beyond those described under *Existing Conditions*.

- ***Direct and Indirect Effects of Action Alternative B***

  The manner in which the riparian zone affects bull trout and westslope cutthroat trout habitat through large-woody-debris recruitment to the stream channel is described under *Large Woody Debris* (previous heading). In that section, the effective riparian zone is described as varying between 81 and 93 feet

along the West Fork and Stryker and Johnson creeks. Since a 100-foot no-harvest buffer would be established between these 3 streams and the associated proposed harvest areas in Action Alternative B, the riparian-zone function associated with these 3 stream channels is not expected to be affected by any of the proposed harvest areas.

Therefore, Action Alternative B would not be expected to have any direct or indirect impacts to the riparian-zone component of bull trout and westslope cutthroat trout habitat in the West Fork or Stryker or Johnson creeks beyond those described under *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative C***

  The direct and indirect environmental effects to the riparian-zone component of bull trout and westslope cutthroat trout habitat for Action Alternative C would be expected to be the same as those described for Action Alternative B.

~ **Stream Temperature**

- ***Direct and Indirect Effects of No-Action Alternative A***

  No-Action Alternative A would not be expected to have any direct or indirect impacts to the stream-temperature component of bull trout and westslope cutthroat trout habitat in the West Fork or Stryker or Johnson creeks beyond those described under *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative B***

  Direct solar radiation is the primary mechanism affecting positive changes in stream temperature throughout the project area. Increases in stream temperature can then, consequently, occur through the loss of riparian vegetation, which intercepts solar radiation. The amount of riparian vegetation intercepting solar radiation, or stream shading, depends on many factors, such as width of the stream channel, site-potential tree height of dominant and co-dominant riparian tree species, riparian tree density, and stream azimuth. Nonetheless, studies with no-harvest riparian buffers of 30 meters (96 feet) in managed, forested watersheds have demonstrated levels of stream shading equivalent to unlogged, forested watersheds (*Beschta et al 1987, Castelle and Johnson 2000 citing others.*) A similar study has found the same results with a 100-foot no-harvest buffer (*Brown and Krygier 1970*). Since a no-harvest buffer of 100 feet would be established between the West Fork and Stryker and Johnson creeks and the associated proposed harvest areas in Action Alternative B, stream temperatures associated with these 3 stream channels are not expected to be affected by any of the proposed harvest areas.

  Tributaries to streams can have an affect on (downstream) stream temperatures that is proportional to the discharge of the tributary. Proposed Harvest Area III-I intersects an intermittent stream channel that eventually delivers seasonal flow to the West Fork, and proposed Harvest Areas III-J and III-L are jointly bordered by an intermittent stream channel that eventually delivers seasonal flow to the West Fork. The intersecting reaches of these 2 first-order, intermittent tributaries would have established buffers for Class I streams according to *Streamside Management Rules (1996)*, which have been shown to have a

statistically insignificant effect on stream temperatures in preliminary studies (*Sugden and Steiner 2003*). As these streams also provide only low, seasonally intermittent discharges to higher-order streams, no measurable or detectable changes in stream temperature would be expected in the West Fork due to Action Alternative B.

Therefore, Action Alternative B would not be expected to have any direct or indirect impacts to the stream-temperature component of bull trout and westslope cutthroat trout habitat in the West Fork or Stryker and Johnson creeks beyond those described under *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative C***

  Although Action Alternative C does not propose any harvesting in Harvest Area III, the consequences in respect to stream temperature would be identical to those of Action Alternative B. Therefore, direct and indirect environmental effects to the stream-temperature component of bull trout and westslope cutthroat trout habitat as a result of the selection of Action Alternative C are expected to be the same as those described for Action Alternative B.

~ Connectivity

- ***Direct and Indirect Effects of No-Action Alternative A***

  No-Action Alternative A would not be expected to have any direct or indirect impacts to the connectivity component of bull trout and westslope cutthroat trout habitat in the West Fork or Stryker or Johnson creeks beyond those described under *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative B***

  As part of Action Alternative B, the bridge crossing the West Fork in Section 29, T34N, R23W, would be replaced with a new 70-foot steel bridge. The new structure would be expected to provide naturally occurring levels of connectivity to all life stages of bull trout and westslope cutthroat trout.

  Therefore, Action Alternative B would not be expected to have any direct or indirect impacts to the connectivity component of bull trout and westslope cutthroat trout habitat in the West Fork or Stryker and Johnson creeks beyond those described under *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative C***

  Direct and indirect effects to the connectivity component of bull trout and westslope cutthroat trout habitat as a result of the selection of Action Alternative C are expected to be the same as those described for Action Alternative B.

CUMULATIVE EFFECTS FOR THE WEST FORK, STRYKER CREEK, AND JOHNSON CREEK

- ***Cumulative Effects of No-Action Alternative A***

  Action Alternative A would not be expected to have any cumulative impacts to bull trout and westslope cutthroat trout in the West Fork and Stryker and Johnson creeks.

- ***Cumulative Effects of Action Alternative B***

  Cumulative impacts are those collective impacts on the human environment of the proposed action when considered in conjunction with other past, present, and future actions related to the proposed action by location or generic type (*75-1-220, MCA*).

The direct, indirect, and collective impacts of past- and present-related actions associated with bull trout and westslope cutthroat trout populations and habitat in the project area for all 3 specific streams are described throughout the *EXISTING CONDITIONS* section. These existing impacts to bull trout and westslope cutthroat trout described earlier range from low to moderate in the West Fork and Johnson Creek and low in Stryker Creek.

There are no known future activities related to the proposed action by location or generic type.

As described in the *Direct and Indirect Effects of Action Alternative B*, the actions associated with proposed Action Alternative B would have impacts to bull trout and westslope cutthroat trout that range from negligible to net positive. The assessment of the proposed actions on bull trout and westslope cutthroat trout populations (presence and genetics) and bull trout and westslope cutthroat trout habitat variables (flow regime, sediment, channel form, large woody debris, riparian-zone function, stream temperature, and connectivity) summarily indicate that no adverse negative impacts would likely be associated with Action Alternative B. Consequently, as a result of the selection of Action Alternative B, the risk of foreseeable, adverse cumulative impacts to bull trout and westslope cutthroat trout is low in the West Fork and Stryker and Johnson creeks.

- ***Cumulative Effects of Action Alternative C***

  Cumulative impacts are those collective impacts on the human environment of the proposed action when considered in conjunction with other past, present, and future actions related to the proposed action by location or generic type (*75-1-220, MCA*).

  The direct, indirect, and collective impacts of past- and present-related actions associated with bull trout and westslope cutthroat trout populations and habitat in the project area are described throughout the *EXISTING CONDITIONS* section for all 3 specific streams. Those existing impacts to bull trout and westslope cutthroat trout, described earlier, range from low to moderate in the West Fork and Johnson Creek and low in Stryker Creek.

  There are no known future-related activities associated to the proposed action by location or generic type.

  As described in *Direct and Indirect Effects of Action Alternative C*, the actions associated with proposed Action Alternative C would have impacts to bull trout and westslope cutthroat trout that range from negligible to net positive. The assessment of the proposed actions on bull trout and westslope cutthroat trout populations (presence and genetics) and bull trout and westslope cutthroat trout habitat variables (flow regime, sediment, channel form, large woody debris, riparian-zone function, stream temperature, and connectivity) summarily indicate no adverse negative impacts would likely be associated with Action Alternative C. Consequently, as a result of the selection of Action Alternative C, the risk of foreseeable, adverse cumulative impacts to bull trout and westslope cutthroat trout is low in the West Fork or Stryker or Johnson creeks.

Appendix F

Wildlife Analysis

APPENDIX F
WILDLIFE ANALYSIS

INTRODUCTION

The discussion in this section pertains to wildlife species and their habitats in the existing environment and changes to that environment due to each alternative.

During the initial scoping, the following issues were expressed regarding the effects of the proposed project:

- Timber harvesting and road use could reduce habitat security of areas for large mammals.
- Timber harvesting and road use could cause fragmentation.

In addition to the above issues, the analyses below discuss other environmental effects of the alternatives to the wildlife resource.

This discussion occurs at 2 scales. The project area includes DNRC-managed lands within Sections 18 through 21 and 28 through 34 in T34N, R23W, and Section 13 in T34N, R24W. Full descriptions of the project area and proposed harvest areas are presented in *CHAPTER II - ALTERNATIVES* (*TABLE II-1 - SILVICULTURAL TREATMENTS BY HARVEST AREA NUMBER FOR ACTION ALTERNATIVES B AND C)*. The second scale relates to the surrounding landscape for assessing cumulative effects. This scale varies according to the species being discussed, but generally approximates the size of the home range of the species in question. Under each grouping or species heading, the description for the cumulative-effects analysis area will be discussed. In the cumulative-effects analysis area, the project area and the effects are placed in a landscape context. If habitat does not exist in the project area or would not be modified by any alternative, species that use that habitat were dismissed from further analysis.

METHODS

To assess the existing condition of the project area and the surrounding landscape, a variety of techniques were used. Field visits, scientific literature, data from the SLI and Montana Natural Heritage Program, aerial photography, consultations with other professionals, and professional judgment provided information for the following discussion and effects analysis. In the effects analysis, changes in the habitat quality and quantity from the existing conditions were evaluated and explained. Specialized methodologies are discussed under the species in which they apply.

COARSE-FILTER ASSESSMENT

DNRC recognizes that it is an impossible and unnecessary task to assess an affected environment or the effects of proposed actions on all wildlife species. We assume that if landscape patterns and processes similar to those that species adapted to are maintained, then the full complement of species will be maintained across the landscape (*DNRC 1996*). This "coarse filter" approach supports diverse wildlife populations by managing for a variety of forest structures and compositions that approximate "historic conditions" across a landscape. To compare present and historical conditions across the landscape, the analysis was conducted for Stillwater State Forest using SLI data (refer to *APPENDIX B - VEGETATION ANALYSIS*) and was compared to the historical assessment compiled for the Lower Flathead Climatic Section (*Losensky 1997*).

Covertypes

The vegetation analysis indicates that covertypes changed over the past century due to the influence of fire suppression, insects, diseases, and timber harvesting. Generally, Stillwater State Forest should support more western white pine and western larch/Douglas-fir covertypes and less subalpine fir and lodgepole pine covertypes than found on average for the climatic type. All other covertypes occur near historical proportions found in the climatic section (*Losensky 1997*). Therefore, species using western white pine and western larch/Douglas-fir covertypes are presumably more likely to be found and/or be more abundant on Stillwater State Forest than on average in the climatic section. Conversely, species using subalpine fir and lodgepole pine covertypes are presumably less likely to occur or occur in lower densities on Stillwater State Forest due to the amount of habitat present, while species that use other covertypes are expected to occur near the average densities expected throughout the climatic section. However, primarily due to fire suppression, timber management, and introduced diseases, many of the stands have increased in the proportion of shade-tolerant tree species (*TABLE F-1 - PERCENTAGE OF COVERTYPES FOUND ON STILLWATER STATE FOREST AND THE CLIMATIC SECTION*). Fire suppression probably had little effect in the project area, while past timber harvesting and diseases heavily influenced the decline in shade-intolerant tree species. The changes presumably reduce the abundance of species that use open, shade-intolerant forested habitat, while favoring species using dense, closed-canopy habitats.

Patch Size and Interior Habitats

Species that are hesitant to cross broad expanses without forest cover, or those that depend upon interior forest conditions, can be sensitive to the amount and spatial configuration of appropriate habitat. Therefore, patch size and juxtaposition can influence habitat quality and population dynamics for some species. Some species are adapted to thrive near patch edges, while others are adversely affected by the presence of edge or by the presence of other animals that prosper in edge habitats.

TABLE F-1 - PERCENTAGE OF COVERTYPES FOUND ON STILLWATER STATE FOREST AND THE 333C CLIMATIC SECTION

COVERTYPE	PERCENT CLIMATIC SECTION (LOSENSKY 1997)	PERCENT OF COVERTYPES ON THE STILLWATER STATE FOREST EXPECTED UNDER HISTORIC CONDITIONS	PERCENT OF COVERTYPES ON THE STILLWATER STATE FOREST EXISTING COVERTYPES CURRENTLY
Douglas-fir	<1	2	2
Lodgepole pine	27	11	11
Mixed conifer[1] (spruce-fir)[2]	6	8	27
Nonforest[1] (wheat-fescue)[2]	Trace	2	2
Other types	Trace	Trace	Trace
Ponderosa pine	1	1	1
Subalpine fir	36	20	26
Western larch/ Douglas-fir	28	45	26
Western white pine	1	11	3

[1] *DNRC classification*
[2] *Losensky (1997) classification*

A "patch" is defined as a unit of habitat with broadly similar age and structural characteristics (primarily associated with forest or nonforest cover). For this analysis, forested habitats provided the basis for patch, interior-habitat, and edge-habitat analyses. Forested habitats were defined as stands greater than 40 years old (pole- to sawtimber-sized stands) with a canopy cover of 40 percent or more. Interior forested habitat is defined as an area that is not affected by the adjacent stand and retains similar climatic conditions. Conversely, edge is defined as the contact zone between 2 different types of habitat. For this analysis, the first 300 feet of a patch was considered edge habitat; the remaining patch was considered interior forested habitat (*TABLE F-2 - EXISTING AND RESULTING FORESTED, INTERIOR, AND EDGE HABITAT ON THE UPPER WHITEFISH GRIZZLY BEAR SUBUNIT*).

Connectivity

Connectivity of forest cover between adjacent patches is important for promoting movements of species that are hesitant to cross broad, nonforest expanses. Stands that are pole-sized or greater with crown closure greater than 40 percent can be important for providing travel cover for forest-dwelling species. Across Stillwater State Forest, connectivity is high with few isolated stands. No harvest areas are proposed in key travel areas, such as saddles or near streams (*FIGURE F-1 - EXISTING FORESTED HABITATS IN THE UPPER WHITEFISH GRIZZLY BEAR SUBUNIT*). See *Canada Lynx* and *Fisher* analyses for additional details on connectivity and travel cover.

Deadwood

Deadwood (downed trees and snags) is an important component of the forested ecosystems. The 5 primary functions of deadwood in the forested ecosystems are to:

1) increase structural diversity,
2) alter canopy microenvironment,
3) promote biological diversity,
4) provide critical habitat for wildlife, and
5) act as a storehouse for nutrient and organic matter recycling agents (*Parks and Shaw 1996*).

This analysis focuses on the importance of deadwood as wildlife habitat and the effects of this project on those habitats.

The presence of insects and predaceous birds and mammals are important to forest management. Both insects and birds associated with snags and downed wood are suspected of controlling insects that are harmful to wood production, such as the Douglas-fir tussock moth and spruce budworm. However, when insect populations reach epidemic levels, predation is often ineffective at controlling or reducing population levels (*Torgensen 1994*). Small mammals that are associated with downed wood distribute ectomychorrhizal fungus, which is needed for seedling establishment and tree growth (*Amaranthus 1998*). Therefore, maintenance of habitats for insectivorous birds and mammals is important for long-term forest health.

Snags and logs provide reproduction, feeding,

TABLE F-2 - EXISTING AND RESULTING ACRES OF FORESTED, INTERIOR, AND EDGE HABITAT IN THE UPPER WHITEFISH GRIZZLY BEAR SUBUNIT

PARAMETER	NO-ACTION ALTERNATIVE A	ACTION ALTERNATIVE B	ACTION ALTERNATIVE C
Forested habitat	21,465	20,278	20,610
Interior habitat	14,771	13,245	13,635
Edge habitat	6,694	7,033	6,975

FIGURE F-1 - EXISTING FORESTED HABITAT IN THE UPPER WHITEFISH GRIZZLY BEAR SUBUNIT

rearing, and/or shelter structure for an array of wildlife species. Deadwood provides insects, fungus, and wood food sources for small mammals. In turn, these small mammals provide prey for predatory birds and mammals. Additionally, deadwood provides animal areas with:

- stable temperatures and moisture,
- shelter from the environment,
- lookout areas, and
- food storage sites.

Small mammals, such as red-backed voles, to large mammals, such as black bears, rely on deadwood for survival and reproduction.

The size, length, decay, and distribution of deadwood affect their capacity to provide specific habitat. Logs less than 6 feet in length tend to dry out and provide limited habitat for wildlife species. Single, scattered logs could provide lookout and travel sites for squirrels or access under the snow for weasels and other small mammals, while log piles provide habitat for weasels, hares, other small mammals, etc. Similarly, diameters, heights, and snag densities determine the snag habitat value for wildlife species. Larger, taller snags tend to provide nesting sites, while shorter snags and stumps tend to provide feeding sites for birds and mammals. Cavity-nesting birds often nest in areas where several snags are available, using individual snags as feeding or roosting sites; therefore, considering the size and distribution of these resources is important.

Snag data were collected in areas where SLI data indicated the stand might meet the old-growth definition defined by *Green et al (1992)*. These areas occurred only in Harvest Area III, which is exclusive to Action Alternative B. Mean snag densities (greater than 14 inches dbh) ranged from 0 to *64* per acre, with an average of *12.6* ($n_{(stands)}$ = *20 [standard deviation = 3.67]*) and *14.0* ($n_{(stands)}$ = *4 [standard deviation = 4.12]*) for stands in cool and moist and cold and moderately dry habitat types, respectively. Only 2 of the sampled stands were harvested in the past. In the harvested stands, snag densities are among the lowest encountered. Whitebark pine was the most common snag encountered (36 percent of all snags), followed by subalpine fir (30 percent), Engelmann spruce (26 percent), and Douglas-fir (8 percent). The live-tree distribution is quite different; Engelmann spruce (75 percent) represents the highest proportion of large trees (greater than 21 inches dbh), followed by subalpine fir (12 percent), Douglas-fir (9 percent), whitebark pine (3 percent), and western larch (2 percent). These trees could provide snag and coarse-woody-debris recruitment in the future. Regeneration in the project area is primarily shade-tolerant Engelmann spruce and subalpine fir. Snag densities in the other harvest areas were subjectively assessed and appear to be relatively low in density, which is expected in previously harvested stands (*Harris 1999*) and near open roads (*Bate et al. 2002*).

COARSE FILTER

Direct Effects to Coarse Filter

- ***Direct Effects of No-Action Alternative A to Coarse Filter***

  No additional displacement or disturbance of wildlife is expected in the area.

- ***Direct Effects of Action Alternatives B and C to Coarse Filter***

  Displacement and/or disturbance of wildlife species would be expected due to these alternatives. Since different species react to human disturbance differently, the extent of disruption would be related to the species in

question. Generally, the amount of harvest area, associated roads, and duration of the project provides an avenue to develop a hierarchy of potential disturbance to wildlife in the area. Both action alternatives would be implemented over a 3-year period. Action Alternative B proposes to harvest 9.5 mmbf of timber from 1,270 acres and construct 3.4 miles of new roads. Action Alternative C proposes to harvest 5.7 mmbf of timber from 938 acres and construct 3.1 miles of new roads. Due to the amount of acres and volume, Action Alternative B would be expected to take longer to complete than Action Alternative C. Due to the increased area and duration of Action Alternative B, Action Alternative B would be expected to produce more disturbances to wildlife species than Action Alternative C. However, the project design features would be incorporated to reduce widespread disturbance of the area (see *Grizzly Bear* analysis).

Indirect Effects to Coarse Filter Covertypes

- ***Indirect Effects of No-Action Alternative A to Covertypes***

  The stands considered for harvesting would continue to age, and the western larch/Douglas-fir covertypes would convert to mixed-conifer or subalpine fir covertypes. Where mixed-conifer and subalpine fir covertypes currently exist, these covertypes would be retained, but these stands would maintain or increase their canopy closure, shading out understory plants and shade-intolerant tree seedlings. In the long-term, species that use the more open stands and/or shade-intolerant tree species, would be negatively affected due to the loss of habitat, while species that use late-successional forest structure, would benefit by an increase in habitat.

- ***Indirect Effects of Action Alternative B to Covertypes***

  Harvesting under this alternative would convert most stands to younger age classes, but would not necessarily change covertypes. On 138 acres, harvesting would promote more historic covertype representation. On the remaining 1,130 acres, the current covertype would be retained; however, shade-intolerant species, such as western larch and western white pine, would be planted in the regeneration-harvest areas to reintroduce or increase their representation in the future stand. DNRC would rely on natural regeneration of whitebark pine to increase or maintain this species in the future stand. These changes would favor wildlife species that use the more-open canopies and shade-intolerant tree species at the expense of wildlife species associated with closed-canopy, shade-tolerant tree species. If whitebark pine successfully regenerates, species such as Clarke's nutcrackers, grizzly bears, squirrels, etc., would benefit from an increase in key food sources.

- ***Indirect Effects of Action Alternative C to Covertypes***

  Harvesting under this alternative would convert most stands to younger age classes, but not necessarily change covertypes. On 46 acres, harvesting would promote a more historic covertype representation. On the remaining 892 acres, the covertype would be retained; however, shade-intolerant species, such as western larch and western white pine, would be planted in regeneration-harvest areas to reintroduce or increase their representation in the future stand. These changes would favor wildlife species that use the more

open canopies and shade-intolerant tree species at the expense of wildlife species associated with closed-canopy, shade-tolerant tree species. Whitebark pine regeneration is not expected in any of these harvest areas.

Patch Size and Interior and Edge Habitats

- ***Indirect Effects of No-Action Alternative A to Patch Size and Interior and Edge Habitats***

  Patch size and interior and edge habitats would not change in the near term. Through time, forested patch size and interior habitat are expected to increase, while edge habitat would be expected to decrease. These conditions would favor wildlife species that prefer dense, mature forests at the expense of wildlife species that use nonforest, open-canopied, or edge habitats.

- ***Indirect Effects of Action Alternative B to Patch Size and Interior and Edge Habitats***

  Forested habitat would decrease by 1,187 acres and interior forested habitat would decrease by 1,526 acres, while edge habitat would increase by 339 acres in the Upper Whitefish Grizzly Bear Subunit (*TABLE F-2 - EXISTING AND RESULTING ACRES OF FORESTED, INTERIOR, AND EDGE HABITAT ON UPPER WHITEFISH GRIZZLY BEAR SUBUNIT*). Habitat for species that use forested and interior habitat would decrease, while species that use edge and regeneration or unforested habitats would be favored.

- ***Indirect Effects of Action Alternative C to Patch Size and Interior and Edge Habitats***

  Forested habitat would decrease by 855 acres and interior forested habitat would decrease by 1,136 acres, while edge habitat would increase by 281 acres in the Upper Whitefish Grizzly Bear Subunit (*TABLE F-2 - EXISTING AND RESULTING FORESTED, INTERIOR, AND EDGE HABITAT ON UPPER WHITEFISH GRIZZLY BEAR SUBUNIT*). Habitat for species that use forested and interior habitat would decrease, while species that use edge and regeneration or unforested habitats would be favored. These effects are intermediate between No-Action Alternative A and Action Alternative B.

Connectivity

- ***Indirect Effects of No-Action Alternative A to Connectivity***

  No change in forest connectivity is expected. Over time, forest connectivity would be expected to increase due to the succession of early seral stands and sparse stands. The increase in connectivity would benefit species that depend on dense interconnected forests by providing movement corridors and other habitats within the project area.

- ***Indirect Effects to Connectivity Common to Action Alternatives B and C***

  Timber harvesting under these alternatives does not substantially alter connectivity. In both alternatives, regeneration harvests would not result in barriers to forest dwelling species under either alternative (*FIGURE F-2 - FORESTED HABITAT IN THE UPPER WHITEFISH GRIZZLY BEAR SUBUNIT*). However, Action Alternative B narrows the connectivity corridor along the West Fork to approximately 500 feet. Under both alternatives, substantial effects to connectivity are not expected; therefore, any effects are expected to be negligible.

Deadwood

- ***Direct and Indirect Effects of No-Action Alternative A to Deadwood***

  No changes in deadwood resources would occur. Tree mortality, especially shade-tolerant tree species, could increase due to insects and diseases or other

FIGURE F-2—FORESTED HABITAT IN THE UPPER WHITEFISH GRIZZLY BEAR SUBUNIT UNDER EITHER ALTERNATIVE

natural events. This situation would benefit species that use deadwood resources in the short term; however, because of the current lack of shade-intolerant tree species in the longer term, reductions in deadwood, especially shade-intolerant tree species, could occur.

- ***Direct and Indirect Effects to Deadwood Common to Action Alternatives B and C***

  Under both alternatives, deadwood resources would be targeted to be retained in the harvest areas. Harvesting could remove recently dead trees that are merchantable, but would attempt to retain most of the cull material. Based on data collected by the USFS on Lolo National Forest, an estimate of snag loss during harvesting activities ranged from 50 to 100 percent (*Hillis 1993*). On a recent DNRC timber sale where all snags greater than 14 inches were to be retained, 60 percent were standing following harvesting; however, when all snags were considered, only 35 percent were left standing. A majority of the loss of snags occurred in the medium-size class, with retention of the larger snags appearing more successful. Therefore, nearly one-half of the snags, mostly small to medium sized, planned for retention in the area could succumb to operational or safety-related felling. These losses are expected to be larger in the cable-yarding harvest areas and exasperated if prescribed fire is used for site preparation.

  In each harvest area, a minimum of 1 snag and 1 snag-recruitment trees over 21 inches dbh would be retained per acre (*ARM 36.11.411*). If snags planned for retention were felled for safety concerns, these trees/snags would be left on site to provide feeding substrate and habitat structure for wildlife species. In all harvest areas, decreases in feeding and nesting sites might occur due to the reduction in snags, while some ground structure and foraging sites could be removed by the harvesting and crushing of downed trees. Harvesting is expected to reduce the densities of small to medium-sized snags; therefore, these alternatives are likely to affect smaller cavity-nesting species and their associated secondary cavity species. However, retention of dominant trees, existing deadwood, and untreated piles of cull logs is expected to provide habitat for species associated with large deadwood in the short and long term. More deadwood habitat would be retained under Action Alternative C than under Action Alternative B. The loss of deadwood structure could reduce insectivorous wildlife species, which could result in increased populations of forest pests (*Torgenson 1994*) and could inhibit regeneration by reducing distribution of ectomychorrhizal fungus distributed by small mammals (*Amaranthus 1998*). However, not all deadwood would be removed from the stand, thereby providing some habitat for these species. The scale of the effects to these species is unknown, but is expected to be related to the reduction in deadwood habitat.

CUMULATIVE EFFECTS - COARSE FILTER

Cumulative Effects to Covertype and Age Class

- ***Cumulative Effects of No-Action Alternative A to Covertype and Age Class***

  Covertypes would continue to convert from shade-intolerant to shade-tolerant covertypes, and stands in older age classes would continue to increase. Where shade-tolerant covertypes are present, shade-intolerant tree densities would continue to decline. This situation would affect wildlife species using the

area by decreasing habitat diversity in the area and favoring species associated with late-succession, shade-intolerant tree species.

- ***Cumulative Effects to Covertype and Age Class Common to Action Alternatives B and C***

  Efforts under both action alternatives would be made to convert stands to more closely reflect the historic conditions outlined in *Losensky (1997)*. Under Action Alternative B, conversion would occur through the thinning of shade-tolerant species and regeneration harvesting. The harvesting would result in more closely reflecting historic covertypes and age classes. This alternative would benefit early successional species at the expense of mid- to later-successional species. The treatments are expected to increase the growth of retained trees, thereby decreasing the amount of time before large trees are available in these stands. These alternatives are expected to benefit native wildlife species by reproducing habitats to which the species are adapted.

Cumulative Effects to Patch Size, Interior and Edge Habitats, and Connectivity

Adjacent USFS lands are not expected to be harvested, thereby increasing forested habitat and patch size in those areas. The effects discussed under the indirect effects above would be cumulative to the conditions occurring on adjacent lands in the area.

Cumulative Effects to Deadwood Resources

Reductions in deadwood resources would be cumulative to past timber and salvage harvests. However, in these areas, mitigations to provide deadwood habitats are incorporated in all these projects. So, although deadwood resources would be reduced in the cumulative effects area, retention of specific snags and downed trees would continue to contribute habitat, albeit at a lower density in the short term, for species that use deadwood resources.

FINE FILTER

In the fine-filter analysis, individual species of concern are evaluated. These species include wildlife species listed under the Endangered Species Act, species listed as sensitive by DNRC (*ARM 36.11.436(6)*), and species managed as big game by DFWP.

THREATENED AND ENDANGERED SPECIES

➢ Bald Eagle

The bald eagle is classified as "threatened" and is protected under the Endangered Species Act. Strategies to protect the bald eagle are outlined in the Pacific States Bald Eagle Recovery Plan (*USFWS 1986*) and the Montana Bald Eagle Management Plan (*Montana Bald Eagle Working Group 1994*). Management direction involves identifying and protecting nesting, feeding, perching, roosting, and wintering/migration areas (*USFWS 1986, Montana Bald Eagle Working Group, 1994*). For the nesting territory at Upper Whitefish Lake, *Paige (1997)* developed site-specific management guidelines that will be followed in this project.

Bald eagles prefer multistoried nesting habitats with 40- to 70-percent canopy cover with emergent trees within topographic line-of-sight to an associated water source with an adequate food supply. The emergent trees and/or snags need to be large enough (more than 25 inches dbh) to support nesting or perching eagles. Additionally, eagles prefer cottonwood, Douglas-fir, and ponderosa pine trees *(Wright and Escano 1986)*. In western Montana, eagles also use western larch and Engelmann spruce.

Eagles nest south of Upper Whitefish Lake. *Paige (1997)* defined the nest area to include the south shoreline of the lake to West Fork Road; the primary use area includes the nest area and extends approximately 1 mile to the north. The home range of these eagles extends north from Swede Creek to Nasukoin Lake and east from the divide between the Swift Creek and West Fork drainages to Hay Lake (*FIGURE F-3 - UPPER WHITEFISH BALD EAGLE TERRITORY*). The eagles return to their breeding territory in February and, if successful in raising eaglets, will inhabit the nest area through August. No proposed harvest areas occur within the nest or primary-use area. However, haul routes intersect the nest and primary-use area. The West Fork Road (open road) borders the south boundary of the nest and primary-use area, while Whitefish Saddle Road (restricted road) cuts through the primary-use area.

To assess cumulative effects to bald eagles, the bald eagle territory home range was used. This area includes DNRC (approximately 33 percent) and National Forest System Lands (approximately 66 percent). Harvest Areas I, II-A, and II-C fall into the bald eagle's home range.

Direct Effects

- ***Direct Effects of No-Action Alternative A to Bald Eagles***

  No additional direct effects to nesting or wintering bald eagles would be expected.

- ***Direct Effects to Bald Eagles Common to Action Alternative B and C***

  No harvesting would occur in the nest or primary-use area. However, hauling through the primary-use area and along the boundary of the nest-site area would occur. To limit disturbance to nesting eagles, Harvest Areas I and II-A would not be harvested during the eagle nesting season (February 1 through August 15) unless the territory is determined to be unoccupied. If needed, logs could be loaded and hauled (but not cut, skidded, or processed) from Harvest Area II-A during the nesting season because the harvest area is along an open road. Loading and hauling would be a short-term disturbance consistent with disturbance found along open roads. However, if this activity is determined to be too disruptive to the nesting eagles, the hauling operation would be discontinued immediately and would start again after August 15. With these mitigation measures in place, no additional disturbance effects are expected.

Indirect Effects

- ***Indirect Effects of No-Action Alternative A to Bald Eagles***

  Timber stands that presently provide bald eagle habitat would continue to increase in density and proportion of shade-tolerant tree species, while decreasing in growth rates. Additionally, snags would continue to develop. Barring any natural disturbance, shade-intolerant trees would not regenerate over time. Existing younger stands would continue to grow and produce the structure needed by eagles, but at a slower rate due to dense stocking. Under this alternative, the quality of eagle nesting habitat would decrease as canopy cover increases above 70 percent (*Montana Bald Eagle Working Group 1991*). The potential of these effects limiting nest success of this breeding pair is low.

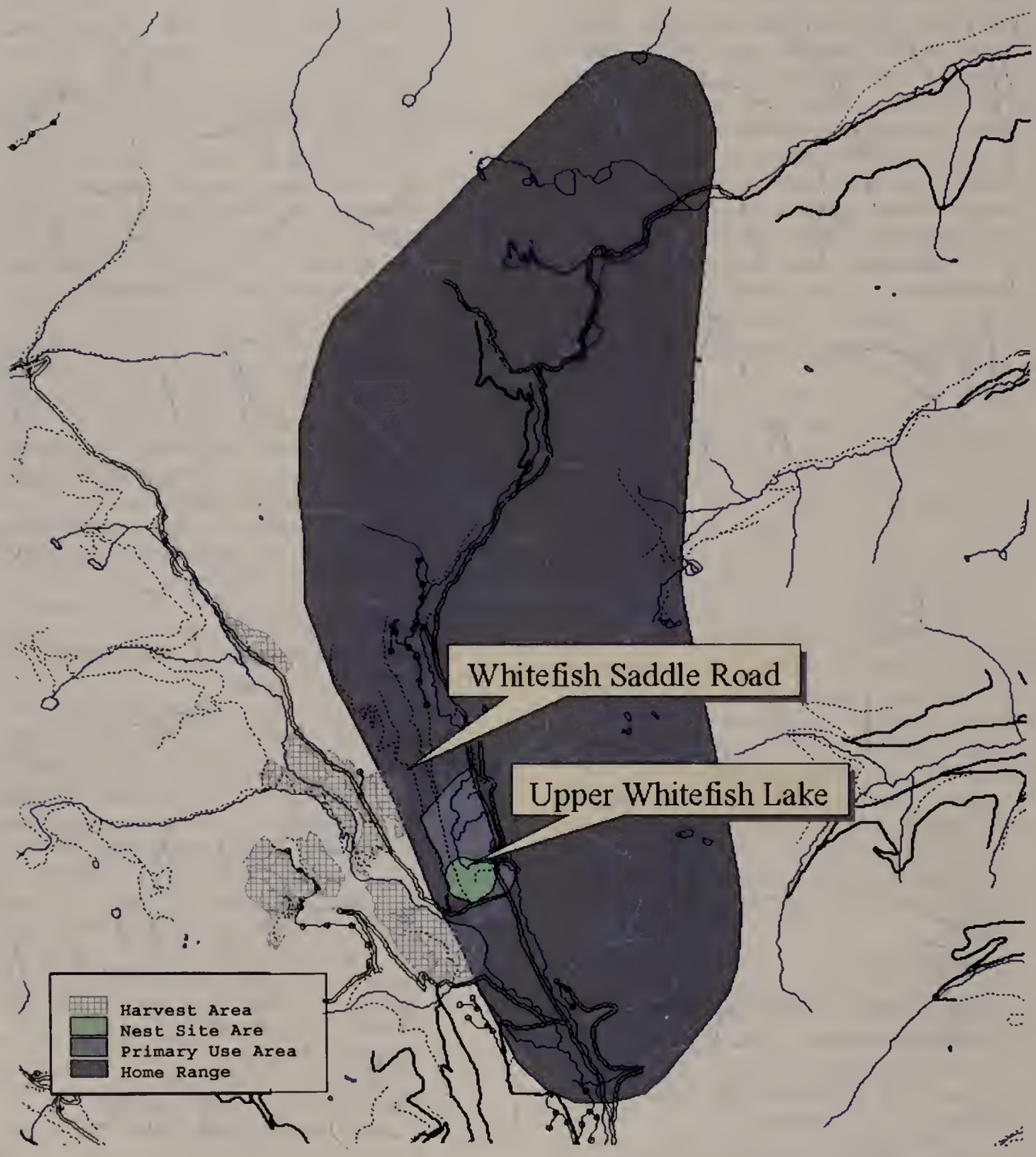


FIGURE F-3 - UPPER WHITEFISH BALD EAGLE TERRITORY

- ***Indirect Effects to Bald Eagles Common to Action Alternative B and C***

  No habitat modifications would occur in the nest site or primary-use area under these alternatives. Therefore, the effects discussed under No-Action Alternative A are expected to occur in these areas.

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A to Bald Eagles***

  Under this alternative, no additional disturbance or habitat modification would occur in the analysis area. No other projects are proposed in the home-range area.

- ***Cumulative Effects to Bald Eagles Common to Action Alternative B and C***

  This alternative would result in treatment of 119 acres of timber within the 17,520-acre home range associated with this territory. None of these stands are located in a landscape position (outside line-of-sight of an associated waterbody) where they provide potential bald eagle nesting habitat. In both Harvest Areas II-A and II-C, regeneration and a group-select harvest prescriptions would be implemented. These treatments would open the overstory canopy, which would increase eagle access to small mammal prey, while retaining dominant trees scattered throughout the harvest area or in groups. Over time, these harvest areas would develop a multilevel canopy. These conversions are expected to be neutral to positive. However, harvesting in Harvest Area II-A would decrease visual screening between the open West Fork Road and the harvest area, thereby offsetting any benefit realized by reducing canopy cover. Otherwise, no other projects are planned in the cumulative-effects analysis area. The effects of these habitat alterations are expected to be neutral to slightly positive, but are not expected to change the reproductive success rate of this nesting pair.

➢ **Canada Lynx**

Canada lynx are listed as "threatened" under the Endangered Species Act. Currently, no recovery plan exists for Canada lynx. Several reports have been written to summarize the research on lynx and develop a conservation strategy (*Ruediger et al 2000*).

Lynx are associated with subalpine fir forests, generally between 4,000 and 7,000 feet in elevation, in western Montana (*Ruediger et al 2000*). Lynx habitat in western Montana consists primarily of young coniferous forest with plentiful snowshoe hares, stands with abundant coarse woody debris for denning and cover for kittens, and densely forested cover for travel and security. Additionally, the mature forests provide habitat for red squirrels, an alternative prey source. These conditions are found in a variety of habitat types, particularly within the subalpine fir series (*Pfister et al 1977*).

To assess lynx habitat, DNRC SLI data were used to map specific habitat classes used by lynx. These areas were considered *lynx habitat* (*ARM 36.11.403(40)*). Other parameters (stand age, canopy cover, amount of coarse woody debris) were used in modeling the availability of specific types of lynx habitat in the area (i.e. denning, forage, other, temporarily not available) (*ARM 36.11.435(2)*).

Based on field reconnaissance and SLI modeling, denning habitat is not expected to be affected, while all harvest areas occur in general

or foraging habitat. The current conditions allow lynx to move through the project area and the proposed harvest areas. All stands proposed for harvesting likely provide red squirrel habitat, and stands or portion of stands with thick understories likely provide snowshoe hare habitat.

Cumulative effects were analyzed for lands in the Upper Whitefish Grizzly Bear Subunit. Based on the above analysis, lynx habitat comprised approximately 26,866 acres, nearly the entire DNRC ownership in the Upper Whitefish Subunit. Of these acres, 915 acres are modeled as denning habitat. The denning habitat component is difficult to model because lynx can den in small patches of downed wood within a large stand. The SLI is designed to identify general stand conditions and does not capture small dense patches of downed woody material; therefore, it is likely that more denning habitat occurs on the landscape than the model predicts. Other classifications used in the modeling effort appear more predictable. ***For existing lynx habitat, see TABLE F-3—EXISTING LYNX HABITAT ON DNRC OWNERSHIP WITHIN THE UPPER WHITEFISH GRIZZLY BEAR SUBUNIT.***

TABLE F-3—EXISTING LYNX HABITAT ON DNRC OWNERSHIP WITHIN THE UPPER WHITEFISH GRIZZLY BEAR SUBUNIT

LYNX HABITAT COMPONENT	*EXISTING ACRES*	*EXISTING PERCENT*
Denning	*915*	*3.4*
Mature foraging	*4,915*	*18.3*
Young foraging	*5,025*	*18.7*
Other available	*13,406*	*49.9*
Temporary nonhabitat	*2,604*	*9.7*
Totals	*26,865*	*100.0*

Direct Effects

- ***Direct Effects of No-Action Alternative A to Canada Lynx***

  No additional activities would occur; therefore, no direct effects would be expected.

- ***Direct Effects to Canada Lynx Common to Action Alternatives B and C***

  Some disturbance of lynx could occur in areas with adequate cover for lynx to travel through. However, lynx appear to be relatively tolerant of human presence and road use (*Mowat et al 2000*); therefore, no substantial direct effects would be expected. A slight potential increase for mortality due to road traffic on gated and/or new roads would be possible, though the risk of this occurring would likely be extremely small. Lynx do not appear to avoid roads at low traffic volumes (Ruediger 2000), so increased logging traffic on open and gated roads is not expected to displace or increase the energetic cost of individual lynx. The risks are higher under Action Alternative B than Action Alternative C, but both alternatives are expected to result in very minor risks of negative direct effects.

Indirect Effects

- ***Indirect Effects of No-Action Alternative A to Canada Lynx***

  Under No-Action Alternative A, lynx would continue to use the project area similarly in the short term because no lynx habitat would be modified under this alternative. In the longer term (barring natural disturbances), stands would continue to age and increase in the coarse woody debris needed for denning and security cover. Regenerating harvest areas would mature and reduce habitat quality for snowshoe hares,

potentially resulting in decreased primary prey availability for lynx. As these stands mature, habitat for red squirrels would increase, somewhat lessening the loss of prey. However, a diet of red squirrels might not provide the nutrients needed for the successful reproduction and rearing of kittens (*Koehler 1990*). Therefore, in the short term, no effects to lynx are expected. In the longer term without disturbance, denning habitat is expected to increase, but foraging opportunities are expected to decrease.

- ***Indirect Effects of Action Alternative B to Canada Lynx***

  Lynx habitat would be modified on 1,270 acres. A regeneration-harvest prescription would be implemented on 1,198 acres; a commercial-thin harvest prescription would occur on the remaining 72 acres. Regeneration harvests would render the harvest area temporarily unsuitable for lynx. Over time, if the harvest areas regenerate to a dense stocking of young trees, snowshoe hare populations in these areas are expected to increase, thereby providing an increase in lynx foraging opportunities. Due to the steep slopes and shrub competition, the harvest areas specific to this alternative (Harvest Area III) might not regenerate successfully enough to provide young foraging habitat. Past harvesting in adjacent areas show sparse regeneration over the past 20 to 30 years. In the proposed regeneration harvest areas (332 acres), tree density is not expected to meet young foraging-habitat criteria, however, the shrub component could provide summer cover for snowshoe hares. Therefore, lynx use of these areas is expected to be limited until the regenerating canopy exceeds 40 percent canopy closure, resulting in marginal habitat in 40 to 80 years. If these stands do not regenerate successfully, lynx habitat would be removed on 332 acres for a long period of time. In Harvest Area I, where a commercial-thin treatment is proposed, harvesting would remove trees that could lead to red squirrel population declines to an unknown degree due to the removal of cone-producing trees (*Pearson 1999*). However, canopy cover would be retained above 40 percent; therefore, the potential for lynx to use or move through this harvest area is expected to continue. Additionally, several slash piles throughout Harvest Area II would be retained following harvesting to potentially provide denning sites near future high quality foraging areas. The regeneration harvest areas and associated piles of cull logs are not expected to be used until dense regeneration occurs. In the short-term, available lynx habitat would decline. As stands regenerate, foraging and denning habitats are expected to increase.

- ***Indirect Effects of Action Alternative C to Canada Lynx***

  The effects discussed above would apply to harvest areas proposed under this alternative; however, the 332 acres discussed above would not be harvested. This alternative is expected to result in the benefits discussed above without the potential long-term loss of habitat on 332 acres in Harvest Area III.

Cumulative Effects

- ***Cumulative Effects of the No-Action Alternative A to Canada Lynx***

  No habitat would be modified. In time, denning habitat would develop on much of the area at the expense of young forage. Snowshoe hare populations would remain relatively stable, but possibly at low densities due to the lack of the temporal high-density, young successional habitats. Under these alternatives, barring any disturbance, forage availability would decrease, while denning habitat would increase.

- ***Cumulative Effects of Action Alternative B to Canada Lynx***

  Under this alternative, 1,198 acres of lynx habitat in the Upper Whitefish Subunit would be converted to 'unsuitable' for 10 to 20 years. The conversion of habitat would be cumulative to other past harvesting on State land; some harvest areas have not fully regenerated in 20 to 30 years. Of this proposed alternative, 332 acres are in areas similar to those that have not regenerated in the past 2 to 3 decades. In the other harvest areas, young foraging habitat is expected to develop. Additionally, denning structure (piles of cull logs) would be left following harvesting, which could increase denning habitat in this subunit. ***Expected effects to lynx habitat components are presented in TABLE F-4 - LYNX HABITAT EXPECTED FOLLOWING HARVESTING UNDER ACTION ALTERNATIVE B.***

TABLE F-4 - LYNX HABITAT EXPECTED FOLLOWING HARVESTING UNDER ACTION ALTERNATIVE B

LYNX HABITAT COMPONENT	FOLLOWING HARVESTING	
	ACRES	PERCENT
Denning	915	3.4
Mature foraging	4,326	16.1
Young foraging	4,977	18.5
Other available	12,856	47.9
Temporary nonhabitat	3,791	14.1
Totals	26,865	100.0

- ***Cumulative Effects of Action Alternative C to Canada Lynx***

  Under this alternative, 866 acres of lynx habitat in the Upper Whitefish Subunit would be converted to *unsuitable* for 10 to 20 years. All proposed harvest areas in this alternative are expected to regenerate successfully; therefore, young foraging habitat is expected to develop in 10 to 20 years. Additionally, denning structure (piles of cull logs) would be left following harvesting, which could increase denning habitat in this subunit. This alternative is expected to impact lynx to a minor degree in the short-term, with greater long-term benefits. ***Expected effects to lynx habitat components are presented in TABLE F-5 - LYNX HABITAT EXPECTED FOLLOWING HARVESTING UNDER ACTION ALTERNATIVE C.***

TABLE F-5 - LYNX HABITAT EXPECTED FOLLOWING HARVESTING UNDER ACTION ALTERNATIVE C

LYNX HABITAT COMPONENT	FOLLOWING HARVESTING	
	ACRES	PERCENT
Denning	915	3.4
Mature foraging	4,489	16.7
Young foraging	5,025	18.7
Other available	12,905	48.0
Temporary nonhabitat	3,531	13.1
Totals	26,865	100.0

➢ Gray Wolf

The gray wolf is listed as "threatened" under the Endangered Species Act. The *Northern Rocky Mountain Wolf Recovery Plan* defines 3 recovery zones (*USFWS 1987*). The proposed project is in the Northwest Montana Recovery Zone. The 3 recovery zones met the recovery standards for the last 2 years and are expected to meet the 10 packs per recovery area this year, initiating the delisting process.

The wolf is a wide-ranging, mobile species. Adequate habitat for wolves consists of adequate vulnerable prey and minimal human disturbance, especially at den and/or rendezvous sites. Primary prey species in northwest Montana are white-tailed deer, elk, moose, and mule deer. The distribution of wolves is strongly associated with white-tailed deer winter ranges. Wolves in northwest Montana typically den in late April. Wolves choose elevated areas in gentle terrain near a water source (valley bottoms), close to meadows or other openings, and near big game wintering areas for dens and rendezvous sites.

The project area contains elk and white-tailed and mule deer nonwinter ranges, which could provide prey for wolves. However, due to the high elevation, denning and rendezvous sites are not expected and harvesting activities would not occur in spring when wolves and their pups are sensitive to human disturbance. Wolf use of the area is expected to be transitory or sporadic; therefore, this project is not expected to affect gray wolves, and this species was dropped from further analysis for this project

➢ Grizzly Bear

Grizzly bears are listed as "threatened" under the Endangered Species Act. The Grizzly Bear Recovery Plan defines 6 recovery areas (*USFWS 1993*). This project is proposed in grizzly bear habitat in the North Continental Divide Ecosystem Recovery Area. The North Continental Divide Ecosystem is divided into subunits. Each subunit approximates the size of a home range for a female bear and is separated from other subunits based on landscape features. This project is proposed in the Upper Whitefish Grizzly Bear Subunit.

The project area provides year-round habitat for grizzly bears. During the spring, bears search for winter-killed big game and lush green vegetation, especially in avalanche chutes. During the summer, bears seek lush green vegetation typically found in riparian areas. In late summer and into autumn, bears switch primarily to a berry diet. The project area contains high elevation, relatively flat basins bounded by steep slopes with numerous avalanche chutes and riparian habitats. Repeated spring observations indicate that grizzly bears could be migrating through the project area between denning sites and spring habitat. During summer and autumn, the basins and riparian habitats in

FIGURE F-4—EXISTING ROADS AND ROAD MANGEMENT IN THE UPPER WHITEFISH GRIZZLY BEAR SUBUNIT

the project area provide high quality habitat for bears. This project could affect grizzly bears directly through increased road traffic, noise, and human activity indicated by changes in road densities, and indirectly by altering the amount and location of hiding cover and forage resources.

The cumulative effects analysis was conducted using the Upper Whitefish Subunit. This subunit is comprised of 84 percent DNRC- and 16 percent USFS-managed lands. This subunit receives a high amount of recreational activities, especially around Upper Whitefish Lake. Recreational use varies by season and includes snowmobiling, ice fishing, camping, fishing, ATV riding, firewood cutting, etc. During the nondenning season, these activities are generally confined to Upper Whitefish Lake, the surrounding area, and along open roads.

Access management is a major factor in managing grizzly bear habitat. The subunit includes several open roads (Upper Whitefish, West Fork, Swede, Stryker Ridge, and Johnson) and the seasonally restricted (March 15 through June 30) Antice Road. Other roads in the area are restricted year-round with gates or berms (*FIGURE F-4 - EXISTING ROADS AND ROAD MANAGEMENT IN THE UPPER WHITEFISH GRIZZLY BEAR SUBUNIT*). To measure disturbance associated with open and total roads, a moving-windows analysis (*Ake 1994*) was used. Additionally, areas that are 500 meters from open or gated roads were defined as potential security core habitat. The road-management scenario in this subunit yields precise-open-road (POR) density (greater than 1 mile per square mile) of 31.8 percent; precise-total-road (PTR) density (greater than 2 miles per square mile) of 33.8 percent; and 51.6 percent of potential-security-core area. DNRC committed to design projects not to exceed the POR or decrease the amount of potential security core realized in 1996 baseline (*ARM 36.11.432 [1][c and d]*), unless approved by the Forest Management Bureau Chief (*ARM 36.11.432 [c][ii]* and *[d][i]*). In 1996, the POR was 32.9 percent, PTR was 41.2 percent (no commitment under *ARM*), and 43.8 percent was security core (*TABLE F-5 - EXISTING AND BASELINE ACCESS-MANAGEMENT PARAMETERS FOR THE UPPER WHITEFISH GRIZZLY BEAR SUBUNIT*). In the present situation, grizzly bears benefited by the reduced disturbance realized in the subunit. Managing motorized access reduces the potential for mortality, displacement from important habitats, and habituation to humans, and provides relatively secure habitat to reduce the energetic requirements (*Interagency Grizzly Bear Committee [IGBC] 1998*).

In addition to the timber harvesting proposed under this alternative, a native culvert restoration project is included. This project would require "walking" an excavator to the head of Stryker Basin to remove earthen fill from over numerous logs that were used to form a culvert for

TABLE F-5 - EXISTING AND BASELINE ACCESS MANAGEMENT PARAMETERS FOR THE UPPER WHITEFISH GRIZZLY BEAR SUBUNIT.

PARAMETER	CURRENT CONDITION	1996 BASELINE
POR density (percent exceeding 1 mile per square mile)	31.8	32.9
PTR density (percent exceeding 2 miles per square mile)	33.8	41.2
Potential security core area (percent greater than 500 meters from potential motorized disturbance)	51.6%	43.8%

the existing road prism. DNRC hydrologist and fisheries biologists are concerned that these culverts will fail in the future and contribute high amounts of sediment to the West Fork of Swift Creek, which could affect bull and westslope cutthroat trout reproduction and survival (refer to *APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS* and *APPENDIX E - FISHERIES ANALYSIS*). Access to these culverts would require use of a road that, presently, is bermed and water-barred, making it relatively impassable to motorized vehicles.

Direct Effects

- ***Direct Effects of No-Action Alternative A to Grizzly Bears***

  No additional direct effects would occur under this alternative.

- ***Direct Effects to Grizzly Bears Common to Action Alternative B and C***

  Under these alternatives, disturbance would increase due to activities in the harvest areas and on the associated access roads. Due to the amount of area, Action Alternative B is expected to result in more direct negative effects than Action Alternative C. The specific road disturbance will be discussed under the cumulative effects analysis.

  To accomplish the harvests, some restricted roads would be used for commercial purposes, but public use would not be allowed over a period of several years. Disturbances associated with these roads are expected to result in decreased use of adjacent habitats by grizzly bears and will be discussed under *Cumulative Effects*.

Indirect Effects

- ***Indirect Effects of No-Action Alternative A to Grizzly Bears***

  No additional habitat would be altered. Hiding cover would be retained within the proposed harvest areas. In time, increases in canopy cover could reduce forage production. No additional disturbance due to road use would occur. Therefore, negligible effects are expected.

- ***Indirect Effects to Grizzly Bears Common to Action Alternatives B and C***

  Under Action Alternatives B and C, timber harvesting would reduce hiding cover. To assess the reduction in hiding cover, hiding cover is expected to be removed in all harvest areas where harvesting reduces overstory cover to 50 percent or less. Timber harvesting would reduce hiding cover in the project area by 1,270 acres under Action Alternative B and 938 acres under Action Alternative C. In both cases, visual screening would be retained along open roads (*ARM 36.11.432[1]*). The loss of hiding cover is expected to be short-term due to the rapid regeneration expected from the shrub component. Therefore, this alternative is expected to result in negligible, short-term (5 to 10 years) negative effects to grizzly bears.

  Following treatment, reduced canopy cover and burning could stimulate berry-producing plants and other forage items (*Marten 1979, Zager 1980*). However, mechanical scarification or a hot fire may reduce the response of berry-producing plants (*Zager 1980*). In areas with large patches of berry-producing plants, attempts would be made to avoid these patches or minimize damage to vegetative

organs when mechanically scarifying the area. Increased forage would be approximately proportional to canopy removal. Therefore, forage increases are expected to be higher with Action Alternative B than Action Alternative C. Additionally, Action Alternative B could increase reproduction of whitebark pine, a high energy autumn food source, by opening the forest canopy in Harvest Area III. The effects of both action alternatives would be positive and minor.

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A to Grizzly Bears***

  Under No-Action Alternative A, motorized access to the area would remain unchanged. In the short-term, hiding cover would be retained at the highest amount of any alternative. Forest succession would continue and could reduce food sources for grizzly bears, but increase the amount of hiding cover. Since hiding cover does not appear limiting in the subunit, maintaining this cover at the expense of food resources could reduce the quality of grizzly bear forage habitat in the subunit through time, resulting in negative minor effects.

- ***Cumulative Effects of Action Alternative B to Grizzly Bears***

  Under Action Alternative B, timber harvesting would not reduce hiding cover below 40 percent in any subunit. Since the subunit contains over 40 percent hiding cover, no measurable effects to grizzly bears are expected.

  Impacts to grizzly bears occur when the open-road density exceeds 1 mile per square mile because at this road density bears tend to avoid otherwise suitable habitat (*Mace et al. 1997*). Under this alternative, grizzly bears are expected to avoid an additional 1,368 acres of habitat due to the increased motorized use on roads associated with the timber harvests. Additionally, 1,052 acres of potential security would be lost (*FIGURE F-5 - EXISTING POTENTIAL SECURITY CORE AREAS AND THOSE AFFECTED UNDER EACH ALTERNATIVE IN THE UPPER WHITEFISH GRIZZLY BEAR SUBUNIT*). Additional losses to security core would occur due to the native-culvert removals in Stryker Basin; however, this disturbance would occur for only about 1 week during the summer period when habitat is most abundant. The disturbance associated with the native-culvert removals would be limited to a backhoe and a small crew that would remove culverts on Stryker Basin Road. This alternative would reduce the amount of habitat available to grizzly bears to less than was available in 1996 and exceeds *ARM 36.11.432(1)(c)* and *(d)*. During alternative development, this alternative received the approval by the Forest Management Bureau Chief (*ARM 36.11.432 [c][ii] and [d][i]*). The loss of habitat increases the energetic cost for grizzly bears using the area. In addition, increased access also increases the risk of mortality for bears. To mitigate this increased risk, any currently restricted road would retain the restriction to the general public. Additionally, contractors would not be allowed to carry firearms on restricted roads (*ARM 36.11.432[1][m]* referencing open-road density levels).

  To mitigate the loss of grizzly bear habitat, several scenarios exist. The use of 3 road systems (Whitefish Saddle, North

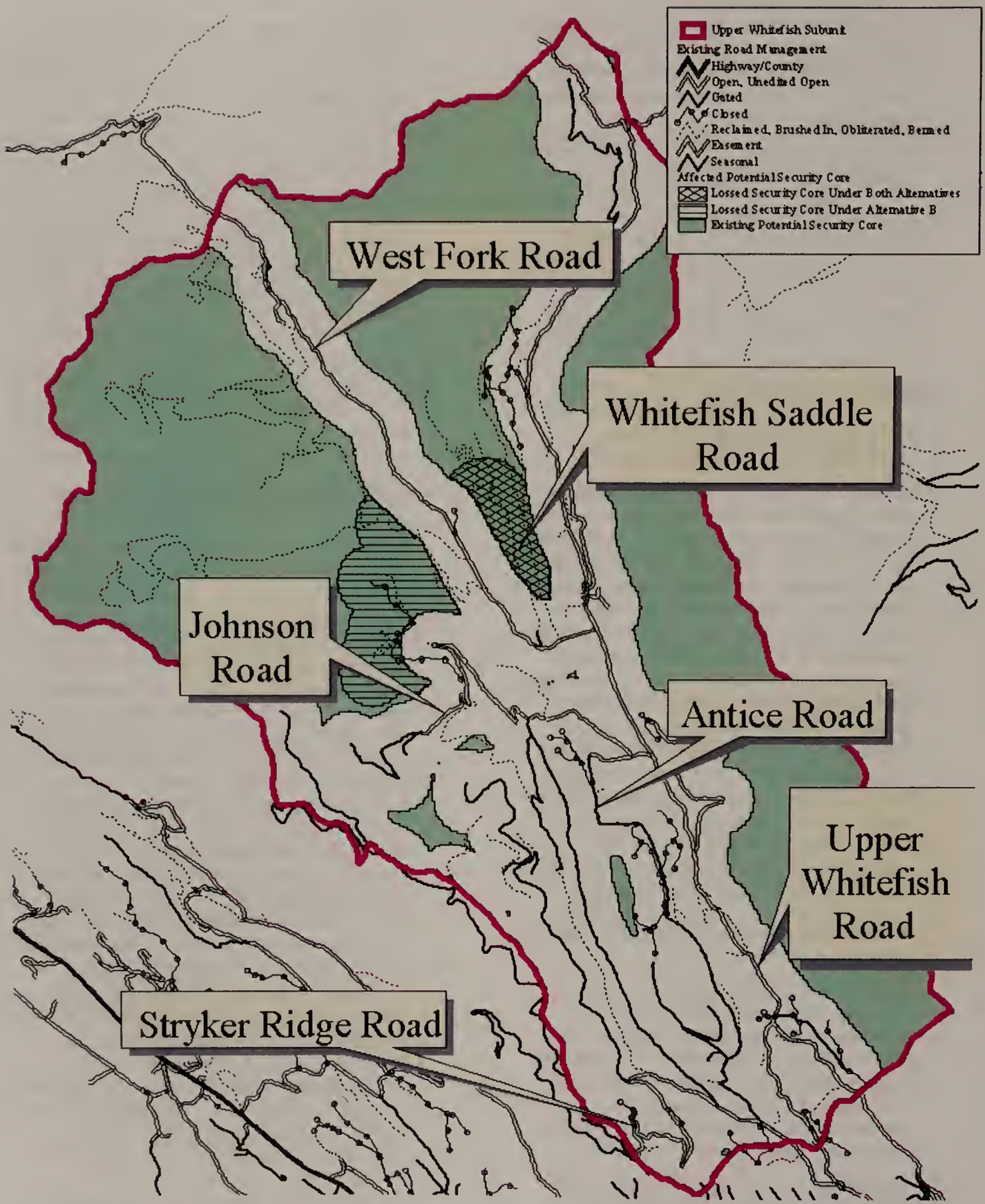


FIGURE F-5—EXISTING POTENTIAL SECURITY CORE AREAS AND THOSE AFFECTED UNDER EACH ALTERNATIVE IN THE UPPER WHITEFISH GRIZZLY BEAR SUBUNIT

Johnson, and Twin Lakes roads) requires mitigation or an exception to *ARM 36.11.432(1)(c)(ii)*.

To mitigate the Whitefish Saddle Road, DNRC would move the existing gate on Johnson Road down to the base of the hill (Site A on *Alternative B Map* in *CHAPTER II*) to maintain road restrictions. Road restrictions would be maintained for the year (April 1 through November 15) that the Whitefish Saddle Road is used for more than 7 trips per week or 30 consecutive days. This scenario successfully mitigates the loss of habitat associated with the construction and use of Whitefish Saddle Road (*TABLE F-6 - THE EXISTING, PROPOSED, AND MITIGATED POR UNDER ACTION ALTERNATIVE B*).

There are several scenarios to mitigate for using the Johnson Road system:

⇒ Scenario 1 would require restriction of Stryker Ridge Road just past the intersection with Antice Road. This restriction would apply for the year(s) that the Johnson Road system was used for more than 7 trips per week or 30 consecutive days. If this were not acceptable,

⇒ Scenario 2 would extend the existing spring seasonal closure on the Antice Road to the full year for each year the Johnson Road system exceeds 7 trips per week or 30 consecutive days of motorized use.

With the Johnson closure mitigation included in the project design and implementation of 1 of the 2 scenarios, grizzly bears could be displaced from the project area; however, DNRC would reduce disturbance in other areas to offset the habitat affected by road use associated with the proposed timber harvests. If these mitigations were implemented, bears would be displaced from the specific habitats in the project area, but would have other habitats secured for them to 'displace into'. Therefore, with the above-mentioned mitigations, the effects of this alternative are expected to be negligible.

Scenarios 1 and 2 both increase the amount of habitat affected as compared to the existing condition; however, both scenarios reduce the amount of habitat affected to less than the 1996 baseline (*TABLE F-6 - THE EXISTING, PROPOSED, AND MITIGATED POR UNDER ACTION ALTERNATIVE B*).

⇒ Scenario 3 would not incorporate road-disturbance mitigations while harvesting in Harvest Area III. The alternative practice authorized by the Forest Management Bureau Chief (*ARM 36.11.432[c]* and *36.11.449*) would be required for this scenario.

With the authorized alternative practice, the increased road disturbance could result in grizzly bears

TABLE F-6 - THE EXISTING, PROPOSED, AND MITIGATED POR UNDER ACTION ALTERNATIVE B

1996 BASELINE	EXISTING CONDITION	ACTION ALTERNATIVE B WITHOUT MITIGATION	JOHNSON CLOSURE MITIGATION	HARVEST AREA III WITHOUT MITIGATION	HARVEST AREA III WITH STRYKER RIDGE CLOSURE MITIGATION	HARVEST AREA III WITH ANTICE CLOSURE MITIGATION
32.9%	31.8%	36.0%	32.7%	34.0%	31.5%	31.4%

avoiding an additional 732 acres over the currently available habitat and 358 acres over the levels experienced during the 1996 baseline. The area where displacement of bears is expected provides good quality summer and autumn habitat. Displacement from these areas during the summer and autumn periods could result in increased energy expenditures and decreased forage consumption resulting in reductions of weight gain. Since bears are dependent on weight gain for survival and reproduction during the denning period, the displacement of bears from these good quality habitats could affect winter survival and reproduction. The scope of these effects is unknown and depends on a bear's ability to live in a disturbed area or seek out suitable undisturbed habitat. These effects would be present for at least the duration of the harvesting activities in Harvest Area III (approximately 3 nondenning seasons).

The combination of the timber harvesting proposed under Action Alternative B and the native culvert removal would reduce potential security core areas to less than the 1996 baseline, thereby violating *ARM 36.11.432(d)*. If this alternative is selected, approval by the Forest Management Bureau Chief would be required (*ARM 36.11.432 [d][i]*). Road access to Harvest Areas III would reduce security core areas by 1,052 acres, but still retain enough security core area to exceed the 1996 baseline. After 1996, Stryker Basin Road was bermed and water barred. This action increased the potential security core by approximately 2,500 acres. Therefore, while the timber sale in Harvest Area III is active, security core areas would be reduced, but would still be above the levels experienced in 1996. The combined use of North Johnson Road for timber harvesting and Stryker Basin Road for accessing the native culverts would result in a loss of security core area to less than 1996 levels. Options to restrict other roads in the subunit for long periods of time are extremely limited and not overly practical. Therefore, an exception to *ARM 36.11.432(d)* would be required for the native culvert removal. This project would occur between August 15 and September 15 and would be expected to last approximately 1 week. The culvert removal could be expected to prevent impacts to bull and native cutthroat trout (see *APPENDIX C—WATERSHED AND FISHERIES ANALYSIS* and *APPENDIX E—FISHERIES ANALYSIS*). The loss of security core area for 1 week during the late summer period is expected to be negligible. In addition, the culvert removal would further inhibit illegal motorized use. Following completion of this project, all roads would revert to their existing management.

- ***Cumulative Effects of Action Alternative C to Grizzly Bears***

  Under Action Alternative C, timber harvesting would not reduce hiding cover below 40 percent in the subunit. Since the subunit estimates are well above 40 percent, no measurable effects to grizzly bears are expected.

  Impacts to grizzly bears could intensify when the open-road density exceeds 1 mile per square mile because at this road density bears tend to avoid

otherwise suitable habitat (*Mace et al. 1997*). Under this alternative, grizzly bears are expected to avoid 556 acres of habitat due to the increased motorized use on roads associated with timber harvesting. To mitigate this increase, the gated closure on Johnson Road would be moved down to the base of the hill (Site A on *Alternative C Map* in *CHAPTER II*). This mitigation would reduce habitat avoidance to 309 acres over the existing condition. This increased amount of habitat disturbance is still less then those experienced during the 1996 baseline conditions. Additionally, 166 acres of potential security core area would be lost for the duration of the harvesting and postharvesting activities in Harvest Area II-P (*TABLE F-7 - THE EXISTING, PROPOSED, AND MITIGATED POR UNDER ACTION ALTERNATIVE C*). Additional losses to security core would occur due to the repair of the native culvert in Stryker Basin. However, this disturbance would occur for only about 1 week during the summer period when habitat is most abundant. This disturbance would be limited to a backhoe and a small crew that would remove culverts on Stryker Basin Road. This alternative would not reduce the amount of habitat available to grizzly bears to less than was available in 1996 and does not exceed the limit of *ARM 36.11.432(1)(c)* or *(d)*. During implementation of the project, small losses of habitat could occur that increase the energetic cost for grizzly bears using the area. In addition, increased access also increases the risk of mortality for bears. To mitigate this increased risk, any currently restricted road would retain the restriction to the general public. Additionally, contractors would be restricted from carrying firearms on restricted roads (*ARM 36.11.432[1][m]*). Since these losses would affect a small area and be short term, this alternative is expected to have minor negative effects. Following completion of this project, all roads would revert to their existing management.

TABLE F-7 - THE EXISTING, PROPOSED, AND MITIGATED POR UNDER ACTION ALTERNATIVE C

1996 BASELINE	EXISTING CONDITION	ALTERNATIVE C	
		WITHOUT MOVING THE JOHNSON GATE	MOVING THE JOHNSON GATE
32.9%	31.8%	34.0%	32.7%

SENSITIVE SPECIES

When conducting forest-management activities, the SFLMP directs DNRC to give special consideration to the several "sensitive" species. These species are sensitive to human activities, have special habitat requirements that may be altered by timber management, or may become listed under the Federal Endangered Species Act if management activities result in continued adverse impacts. Because sensitive species usually have specific habitat requirements, consideration of their needs serves as a useful "fine filter" for ensuring that the primary goal of maintaining healthy and diverse forests is met. The following sensitive species were considered for analysis. As shown in *TABLE F-8 - LISTED SENSITIVE SPECIES FOR NWLO SHOWING THE STATUS OF THESE SENSITIVE SPECIES IN RELATION TO THIS PROJECT*, each sensitive species was either included in the following analysis or dropped from further analysis for various reasons.

TABLE F-8 - LISTED SENSITIVE SPECIES FOR NWLO SHOWING THE STATUS OF THESE SPECIES IN RELATION TO THIS PROJECT

SPECIES	DETERMINATION - BASIS
Black-backed woodpecker	No further analysis conducted - No burned habitat occurs in the project area.
Coeur d'Alene Salamander	No further analysis conducted - No moist talus or streamside talus habitat occurs in the project area.
Columbian sharp-tailed grouse	No further analysis conducted - No suitable grassland communities occur in the project area.
Common loon	No further analysis conducted - Neither alternative would occur near Upper Whitefish Lake.
Ferruginous hawk	No further analysis conducted - No suitable grassland communities occur in the project area.
Fisher	*Included* - Potential fisher habitat occurs in the project area.
Flammulated owl	No further analysis conducted - No dry ponderosa pine habitats occur in the project area.
Harlequin duck	No further analysis conducted - Neither alternative would occur near Swift Creek.
Mountain plover	No further analysis conducted - No suitable grassland communities occur in the project area.
Northern bog lemming	No further analysis conducted - No sphagnum bogs or other fen/moss mats occur in the area.
Pileated woodpecker	*Included* - Western larch/Douglas-fir and mixed conifer habitats occur in the area.
Townsend's big-eared bat	No further analysis conducted - No caves or mine tunnels occur in the project area.

Fisher

Due to their use of mature and late-successional forested habitats, fishers are listed by DNRC as a sensitive species (*DNRC 1996*). DNRC's strategy to conserve fishers in a managed landscape is aimed at protecting valuable resting habitat near riparian areas and maintaining travel corridors.

Fishers are generalist predators and use a variety of successional stages, but are disproportionately found in stands with dense canopy (*Powell 1982, Johnson 1984*). Fishers appear to be highly selective of resting and denning sites. In the Rocky Mountains, fishers appear to prefer late-successional coniferous forests for resting sites and use riparian areas disproportionately to their availability. Fishers tend to use areas within 155 feet of water. Such areas contain large live trees, snags, and logs, which are used for resting and denning sites and dense canopy cover, which is important for snow intercept (*Jones 1991*). Field reconnaissance indicates that all of the proposed harvest areas provide fisher habitat. However, in some of the areas, large snags and downed wood are rare, while relatively abundant in other areas. Timber harvesting and associated road construction could affect fishers by altering habitat and/or increasing susceptibility to trapping.

Trapping pressure was responsible for the extirpation of fisher over most of their range by the 1930s. Although they again inhabit this area, populations remain vulnerable to trapping because fishers are easily caught in traps set for martens, bobcats, and coyotes; however, fishers are rare and are not trapped often. Vulnerability to trapping is influenced by the miles of road, both open and closed.

The Upper Whitefish Grizzly Bear Subunit was used to assess cumulative effects. For a description of the subunit and ownership, refer to the *Grizzly Bear* portion of this analysis. In the cumulative effects analysis area, State trust lands provide potential denning/resting, foraging, and travel habitats. Currently, these areas are highly connected, thereby allowing fishers to use and move relatively unimpeded through the project area and the subunit.

Direct Effects

- ***Direct Effects of No-Action Alternative A to Fishers***

  No additional human disturbance or increased vulnerability to trapping would occur.

- ***Direct Effects to Fishers Common to Action Alternative B and C***

  Under each action alternative, some displacement could occur; however, the effects of this displacement would be minor. The risk of displacement is approximately proportional to the amount of habitat affected; therefore, Action Alternative B (1,270 acres) poses more risk than does Action Alternative C (938 acres).

  Under Action Alternative B, 3.4 miles of new or temporary road would be constructed, while 3.1 miles of road would be constructed under Action Alternative C. The new temporary roads would increase access into the project area. Following use, these roads would be obliterated or restricted, thereby inhibiting use during the nonwinter period. However, during the winter period, access into the harvest areas via snowmobile would be increased. This increased access could result in increased fisher

mortality due to trapping. However, since fishers are rare and many of the areas are already accessible, no substantial changes to fisher vulnerability are expected.

Indirect Effects

- ***Indirect Effects of No-Action Alternative A to Fishers***

  Fisher habitat would remain relatively unchanged in the short-term. In the longer-term, more resting/denning habitat would develop. Fishers would benefit from the increased habitat and no increase in mortality risk, resulting in a potential increase in fisher use in the area.

- ***Indirect Effects of Action Alternative B to Fishers***

  Under Action Alternative B, 1,270 acres of habitat would be modified. In regeneration-harvest areas (1,198 acres), harvesting would remove fisher habitat for a period of time (15 to 30 years) and reduce the habitat quality in the adjacent stands, because fishers avoid openings (*Roy 1991, Jones 1991*) and are rarely detected near abrupt-edge habitat adjacent to clearcuts (*Heinemeyer, unpublished*). The retention of seedtrees and snags would provide resting/denning structure for the future stand. However, these resources would be reduced by nearly 50 percent following harvesting. The regenerating areas could provide foraging habitat (snowshoe hare habitat) in the future (15 to 30 years). A 100-foot, no-harvest buffer along the West Fork and Stryker and Johnson creeks would be retained to protect potential high quality resting habitat and travel corridors, since fishers travel along stream courses and prefer habitats in proximity of water (*Jones 1991, Heinemeyer 1993*). This proposed alternative would reduce fisher habitat in the harvest areas; however, habitat and travel corridors along perennial streams would be retained to provide fisher resting/denning habitat and allow movement through the project area. Within each harvest area, snags and large trees would be retained to provide denning/resting sites in the future. This would reduce the amount of time needed to become fisher habitat from 100+ years to develop resting structure to 15 to 30 years needed to develop horizontal cover. The reduction of denning/resting sites and foraging habitat in the uplands would result in increased energy expenditures, while decreasing forage opportunities. This alternative is expected to remove fisher habitat, while retaining travel corridors along stream courses, resulting in minor negative effects to fishers.

- ***Indirect Effects of Action Alternative C to Fishers***

  Under Action Alternative C, the same effects discussed above are expected; however, this alternative would not harvest in Harvest Area III (332 acres). Harvest Area III has less desirable fisher habitat than the other areas in the flatter topography; therefore, this alternative would result in slightly less minor effects to fisher.

Cumulative Effects

- ***Cumulative Effects of All Alternatives to Fishers***

  Salvage operations and firewood cutting on State trust lands has decreased habitat. Salvage and regeneration harvests, especially in mature and late successional stands, has reduced

the amount of habitat available on State trust lands. Habitat conditions on USFS lands are expected to improve in time; however, these lands occur higher in the drainage and are probably used less by fishers than the lower elevations. Under all alternatives, movement corridors from the project area into the cumulative effects area would be retained. The effects of the new roads discussed above would also apply to the cumulative effects area. Overall, Action Alternative B would combine with other activities on DNRC-managed to produce minor negative effects to fishers. Slightly less minor effects are expected under Action Alternative C.

➢ Pileated Woodpecker

Pileated woodpeckers, listed by DNRC as sensitive, play an important ecological role by excavating cavities that are used in subsequent years by many other species of birds and mammals.

Pileated woodpeckers excavate the largest cavities of any woodpecker. Preferred nest trees are western larch, ponderosa pine, cottonwood, and quaking aspen, usually 20 inches dbh and larger. Pileated woodpeckers primarily eat carpenter ants, which inhabit large downed logs, stumps, and snags. *Aney and McClelland (1985)* described pileated nesting habitat as "stands of 50 to 100 contiguous acres, generally below 5,000 feet in elevation with basal areas of 100 to 125 square feet per acre and a relatively closed canopy." The feeding and nesting habitat requirements, including large snags or decayed trees for nesting and downed wood for feeding, closely tie these woodpeckers to mature forests with late-successional characteristics. The density of pileated woodpeckers is positively correlated with the amount of dead and/or dying wood in a stand (*McClelland 1979*).

Potential pileated woodpecker nesting habitat was identified by searching the SLI database for 'old stands' with more than 100 square feet basal area per acre, more than 40 percent canopy cover, and below 5,000 feet in elevation. Due to the relatively high elevation of the project area, the pileated woodpecker is limited to the drainage bottoms in the project area. Only Harvest Area II (except Subarea II-H) provides pileated woodpecker habitat. Harvest Areas I and III are above 5,000 feet in elevation and are unlikely to be used often or heavily. Older-aged stands with dense amounts of deadwood would provide pileated with nesting habitat, younger-aged stands could provide feeding or lower quality nesting habitats. Since even the subareas in Harvest Area II are at the upper extremes used by pileated woodpeckers, this habitat is probably marginal.

The project area is large enough (approximately 5,035 acres) to provide habitat for several pairs of pileated woodpeckers. Of this area, approximately 3,000 acres occur at less than 5,000 feet in elevation, with 433 acres currently unsuitable due to past harvesting. Since the project area could provide habitat for several pairs of pileated woodpeckers, the cumulative-effects analysis area is the project area.

Direct Effects

- ***Direct Effects of No-Action Alternative A to Pileated Woodpeckers***

  No disturbance of pileated woodpeckers would occur.

- ***Direct Effects to Pileated Woodpeckers Common to Action Alternatives B and C***

  Under the action alternatives, pileated woodpeckers could be affected if harvesting occurred during the nesting period. Nesting woodpeckers could be displaced by harvesting activities. The effects of harvesting disturbance are unknown; however, *Bull et al. (1995)* observed a discernible woodpecker roosting near a harvest area consistently throughout harvesting. Additionally, mortality of individual woodpeckers could occur if nest trees were inadvertently cut. This risk would be low because most nest trees possess some rot; therefore, they have low merchantability and would likely not be harvested. Action Alternative B would result in a low risk of directly affecting pileated woodpeckers. Action Alternative C would result in a slightly less risk of directly affecting pileated woodpeckers than Action Alternative B.

Indirect Effects

- ***Indirect Effects of No-Action Alternative A to Pileated Woodpeckers***

  The existing trees would continue to grow and die, thus providing potential nesting and foraging substrate for pileated woodpeckers. However, as these trees die, barring any disturbance, replacement trees (shade-intolerant) would not be present. Therefore, under this alternative, pileated woodpecker habitat would increase through time, then decline, resulting in a short- to mid-term moderate beneficial effect to pileated woodpeckers, but a long-term minor negative effect.

- ***Indirect Effects to Pileated Woodpeckers Common to Action Alternatives B and C***

  Under Action Alternatives B and C, 775 acres of pileated woodpecker habitat in the project would be modified. All of these areas would experience a regeneration harvest, thereby reducing the quality of nesting habitat for a long period of time in all proposed harvest areas (*McClelland 1979*). Some of the dominant and clumps of trees would be retained and would be expected to increase growth rates due to reduced competition. Additionally, large snags would be targeted for retention, especially western larch snags greater than 21 inches dbh, thereby retaining some feeding and nesting structures in the harvest area. However, some snags could be lost due to harvesting. These snags would be left on site to provide feeding substrates for pileated woodpeckers and other wildlife species. These alternatives are expected to result in negligible negative effects to pileated woodpeckers. In the longer term, seral species would be planted under this alternative and could provide pileated woodpecker habitat in the distant future.

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A to Pileated Woodpeckers***

  Pileated woodpecker habitat in and around the project area would increase through time on DNRC lands, then decline. This alternative would result in continued retention of the existing pileated woodpecker habitat on DNRC lands. These conditions would result in continued retention of pileated woodpecker habitat.

- ***Cumulative Effects to Pileated Woodpeckers Common to Action Alternatives B and C***

  Under Action Alternatives B and C, potential habitat would be reduced; this loss would be additive to past harvesting and salvaging on DNRC lands. Under both action alternatives, pileated woodpecker habitat in the analysis area would be reduced by 775 acres. The reduction is expected to cumulatively contribute to reduced habitat quality and quantity in the analysis area. However, since the analysis area occurs in higher elevation and, presumably, lower habitat quality, any effects would be negligible. ***Following harvesting, enough habitat is expected to remain in the project area to support at least 1 pair of woodpeckers.*** The long-term minor benefit could be realized by the regeneration of shade-intolerant tree species that are important nesting structures.

BIG GAME SPECIES

Deer, elk, and moose inhabit the project area. However, due to heavy snow accumulations and high elevation, big game use of the project area is restricted to the nonwinter period. During the nonwinter period, forage and hiding cover are important components for these species. The project area provides dense hiding cover in both harvested and unharvested stands. To assess cumulative effects, the Upper Whitefish Grizzly Bear Subunit was considered.

DIRECT EFFECTS

- ***Direct Effects of No-Action Alternative A to Big Game Species***

  No additional human disturbance or increased vulnerability to hunting would occur.

- ***Effects of Action Alternative B and C to Big Game Species***

  Under each action alternative, some displacement could occur; however, the effects of this displacement would be minor. The risk of displacement is approximately proportional to the amount of habitat affected; therefore, Action Alternative B (1,270 acres) poses more risk than does Action Alternative C (938 acres). Any use of restricted roads during the project period would require the contractor to keep the road restricted to the public with a sign during active periods and with a locked gate during inactive periods (nights, weekends, breakdowns, etc.). This mitigation measure would result in no increased direct effects to big game species.

INDIRECT EFFECTS

- ***Indirect Effects of the No-Action Alternative A to Big Game Species***

  No changes to big game habitat would occur in the short-term. In the longer-term, forage items could be reduced as canopy cover increases. These changes would be slow and localized. Hiding cover is not expected to change dramatically over time. This alternative is expected to result in negligible effects.

- ***Indirect Effects of Action Alternative B and C to Big Game Species***

  Removal of the overstory canopy closure is expected to increase forage items, but would also reduce hiding cover. The reduction in hiding cover is expected to be short-term due to the rapid regrowth of shrubs in the project area. Visual screening would be retained along open roads in the project area. Since Action Alternative B would affect more area than Action Alternative C, these effects would be more pronounced in the project area under Action Alternative B.

However, these effects are expected to be negligible and could result in slight habitat shifts.

CUMULATIVE EFFECTS

- ***Cumulative Effects of All Alternatives to Big Game Species***

  Under all alternatives, vegetative cover, especially along streams, would allow movement into and out of the project area. Harvest areas are expected to increase forage production in the cumulative effects area, with Action Alternatives B expected to produce more forage than Action Alternative C. No increases in forage production are expected due to No-Action Alternative A. Since no other projects are planned in the cumulative effects area, the effects discussed for the project area also hold true for the cumulative effects area.

APPENDIX G
ECONOMIC ANALYSIS

INTRODUCTION

The West Fork Timber Sale Project is located in Stillwater State Forest, north of Whitefish in Flathead County. The project is in an area of relatively low population density and has produced timber for the area mills since the early 1900s. The focus of the economic section will be on market activities that directly or indirectly benefit the Montana education system, generate revenue for the school trust funds, and provide funding for public buildings.

Flathead and Lincoln counties have historically provided both manufacturing and recreational pursuits. Manufacturing has historically focused on mining and timber, as well as a limited amount of agriculture processing. Recreation has focused on Glacier National Park, as well as the many lakes and mountains in the region. Mining has declined within the area in recent years, while timber has remained comparatively steady or declined slightly.

EXISTING CONDITIONS

The location of Stillwater State Forest in relation to purchasers likely to be interested in timber sales necessitates analyzing economic and demographic data for both Flathead and Lincoln counties, although there is a potential for purchasers further south and west to be interested in this sale. *TABLE G-1 - SELECTED DEMOGRAPHIC INFORMATION FOR FLATHEAD AND LINCOLN COUNTIES* contains selected demographic information for each of these counties and for the entire State.

TABLE G-1 - SELECTED DEMOGRAPHIC INFORMATION FOR FLATHEAD AND LINCOLN COUNTIES

Demographic	Flathead	Lincoln	Montana
Population 1990	59,218	17,481	799,065
Population 2000	74,471	18,837	902,195
Growth Rate	2.4%	0.8%	1.2%
Median Age	37.2	38.2	37.8
School Enrollment	13,000	3,012	157,560

Flathead County is known for its production of "Flathead cherries". Flathead County also has a large wood-products sector producing a variety of products that include dimensional lumber, plywood, and molding. In addition to wood products, Flathead County also has a large recreation industry that include the primary entrances to Glacier National Park and Big Mountain, a large and major ski destination.

Lincoln County is located in the northwest corner of Montana. Historically, both mining and wood manufacturing played a large role in the County's economic activities. In recent years, mining has declined in the region and the timber industry has remained as one of the primary employers. An abundance of forests, lakes/streams, and wildlife have made the area also heavily used by recreationalists.

School enrollment for kindergarten through grade 12 in the 2 counties combined is over 16,000.

The data in *TABLE G-2 - COVERED WAGES AND EMPLOYMENT IN 2002 FOR SELECTED INDUSTRIES IN FLATHEAD AND LINCOLN COUNTIES* shows employment and income in selected industry categories for each of the 2

TABLE G-2 - COVERED WAGES AND EMPLOYMENT IN 2002 FOR SELECTED INDUSTRIES IN FLATHEAD AND LINCOLN COUNTIES

INDUSTRY	FLATHEAD COUNTY			LINCOLN COUNTY		
	AVERAGE ANNUAL EMPLOYMENT	ANNUAL WAGES (000)	AVERAGE WAGE	AVERAGE ANNUAL EMPLOYMENT	ANNUAL WAGES (000)	AVERAGE WAGE
Agriculture, forestry, and fishing	424	$13,717	$32,340	236	$6,655	$28,201
Forestry	70	10,392	36,898	210	5,893	28,020
Construction	2,411	73,054	30,295	193	5,190	26,928
Manufacturing	3,264	122,266	37,461	664	21,082	31,755
Lumber	1,426	55,536	38,945	575	19,190	33,384
Metals	475	21,280	44,800	NA	NA	NA
Transportation	659	18,072	27,410	127	2,554	20,180
Trade	5,776	124,546	21,563	640	10,144	15,850
Eating and drinking establishments	2,685	29,392	10,259	363	2,969	8,178
Finance, insurance, and real estate	1,797	57,826	32,180	163	7,388	19,907
Services	9,736	290,648	19,875	1,554	24,177	15,557
Hotels, etc.	1,254	18,908	15,074	99	1,101	11,109
Amusement and recreation	952	12,667	13,306	81	985	12,221
Government	4,389	136,196	31,035	1,393	42,552	30,542
Total all industries	33,446	$853,132	$25,508	5,085	$118,983	$23,399

counties that are included in the analysis. Economic activity within the 2 counties varies substantially, although both counties have timber-related industry present. Lincoln County is less populated and less developed than Flathead County.

Lincoln County has a substantially smaller labor force and a smaller number of workers employed in timber-related jobs. The average wage in the timber industry is 53 percent higher than the overall average wage in Flathead County (38,945 divided by 25,508 times 100) and 43 percent higher than the overall average wage in Lincoln County (33,384 divided by 23,399 times 100). Service-industry wages are lower than the overall average wage in both counties. The service industries provide employment for over twice as many workers as the timber industry in Lincoln County and nearly 9 times as many workers as the timber industry in Flathead County. The average wage in the service industry is almost one-half of the average wage in the timber industry in both counties.

ALTERNATIVE EFFECTS

DIRECT EFFECTS

Three options are being analyzed in this Environmental Impact Statement: No-Action Alternative A; Action Alternative B, which includes harvesting an estimated 61,750 tons (9.5 MMBF) of timber; and Action Alternative C, which includes harvesting an estimated 37,115 tons (5.7 MMBF) of timber. The following estimates are intended for relative comparison of alternatives and not intended to be absolute estimates of returns, taxes, employment, or wages.

- ***Direct Effects of No-Action Alternative A***

  None of the employment, income, or trust fund effects that result from the action alternatives would occur.

- ***Direct Effects of Action Alternatives B and C***

  Timber Sale Effects

  TABLE G-3 - ESTIMATED REVENUES AND EXPENDITURES FROM THE WEST FORK OF SWIFT CREEK TIMBER SALE PROJECT displays the estimated revenue and expenditures associated with the West Fork Timber Sale Project. The 2 alternatives analyzed may, for administrative purposes, be broken into smaller sales, but are treated as a unit for the purpose of this analysis. The volume for Action Alternative B is 61,750 tons, or 9.5 MMBF. The corresponding volume associated with Action Alternative C is 37,115 tons, or 5.7 MMBF. The areas associated with each alternative are identified in the map section of Chapter II.

  Broader market and local stumpage prices are currently well above the long-term average. These prices are highly dependent on the housing market and foreign timber imports. The housing market is highly dependent on the interest rate, which, in part, determines who can "qualify" to purchase a home. Interest rates are currently at very low levels; these low levels have not been seen since the late 1950s and early 1960s. Low interest rates normally impact the housing market by stimulating new construction to satisfy the demand for housing from individuals who can now "qualify" to purchase a home. The growth of the economy appears to be increasing, as the economic effects of the bombing of the World Trade Center on September 11, 2001 continues to decline. The result of the growth and low interest rates has been a continued strong housing market. Mortgage interest rates appear to be remaining at low levels, which helps keep the demand for housing strong.

  Restricted imports of timber and sheet goods from other countries, primarily Canada, have helped bolster prices by reducing the supply of

TABLE G-3 - ESTIMATED REVENUES AND EXPENDITURES FROM THE WEST FORK OF SWIFT CREEK TIMBER SALE PROJECT

	ACTION ALTERNATIVE B	ACTION ALTERNATIVE C
Harvest volume	61,750 tons	37,115 tons
Stumpage price $/ton	$26.55	$25.50
Forest improvement ***fund revenue ($10.20/ton)***	$631,750	$379,700
Stumpage revenue ***(harvest volume times stumpage price)***	$1,639,100	$947,600
State income ***(FI revenue plus stumpage revenue)***	$2,270,850	$1,327,300
Trust income ***(stumpage revenue minus expenditures)***	$677,900	$359,000
Expenditures*	$961,200	$588,600

Source: DNRC, Trust Land Management.
**The State does not identify expenses for individual timber sales. The estimates used here are based on area-wide averages of the timber sale program.*

timber available to homebuilders. In addition, the demand for U.S. timber has increase due to a combination of economic recovery in several countries and the devaluation of the U.S. dollar, which makes our timber relatively cheaper to foreign buyers. The timber prices used in this analysis attempt to recognize the current market conditions.

Underlying Assumptions

Project impact estimation and analysis assumes that most of the economic impact associated with the sales would take place in the 2-county area. The estimates are intended for comparative purposes and do not purport to be the value of the impacts in any absolute sense. Stumpage prices were determined using the current transaction equation modified by professional judgment to reflect current and local market conditions as much as possible. ***The estimated stumpage price per ton for Action Alternative B is slightly higher than Action Alternative C because Action alternative B has a greater volume of timber for sale, higher volume of timber per acre, and higher value material due to the quality of wood and average dbh.***

Fees collected for the FI fund are collected from the purchaser of the timber sale as part of their bid. Activities funded under this program include site preparation, tree planting, thinning, roadwork, right-of-way acquisition, etc. The current FI fee for the NWLO area is $66.50 per MBF.

TABLE G-4 - NUMBER OF STUDENTS SUPPORTED BY 1 YEAR OF ESTIMATED REVENUE shows the difference in revenue to the trusts from the 2 action alternatives.

The school trust income from a timber sale under Action Alternative B is estimated to be $677,900; enough to fund the education of 96 students for 1 year based on an average cost of $7,080, as determined by information provided by the Montana Office of Public Instruction. This information is shown in *TABLE G-4 - NUMBER OF STUDENTS SUPPORTED BY 1 YEAR OF ESTIMATED REVENUE*. If the sale does not take place, no students are benefited. A "cost" of not harvesting, compared to harvesting the timber under Action Alternative B, is the loss of financing for 96 kindergarten through grade 12 students for 1 year.

The school trust income from a timber sale under Action Alternative C is estimated to be $359,000; enough to fund the education of 51 students for 1 year based on an average cost of $7,080, as determined from information provided by the Montana Office of Public Instruction. This information is shown in *TABLE G-4 - NUMBER OF STUDENTS SUPPORTED BY 1 YEAR OF ESTIMATED REVENUE*. If the sale does not take place, no students are benefited. Thus, one of the "costs" of not harvesting the timber, compared to harvesting under Action Alternative C, is the loss of financing for 51 kindergarten through grade 12 students for 1 year.

If the trust does not fund these students through the sale of timber, funding must come from other sources, primarily property taxes.

TABLE G-4 - NUMBER OF STUDENTS SUPPORTED BY 1 YEAR OF ESTIMATED REVENUE

	ACTION ALTERNATIVE	
	B	C
Estimated school revenue	$677,900	$359,000
Students supported*	96	51

Source: Montana Department of Natural Resources and Conservation, Trust Land Management
**Assumes all of the "trust" income would be distributed for educational purposes. Depending on the trust, some of the income is distributed to a fund that earns revenue for future education funding.*

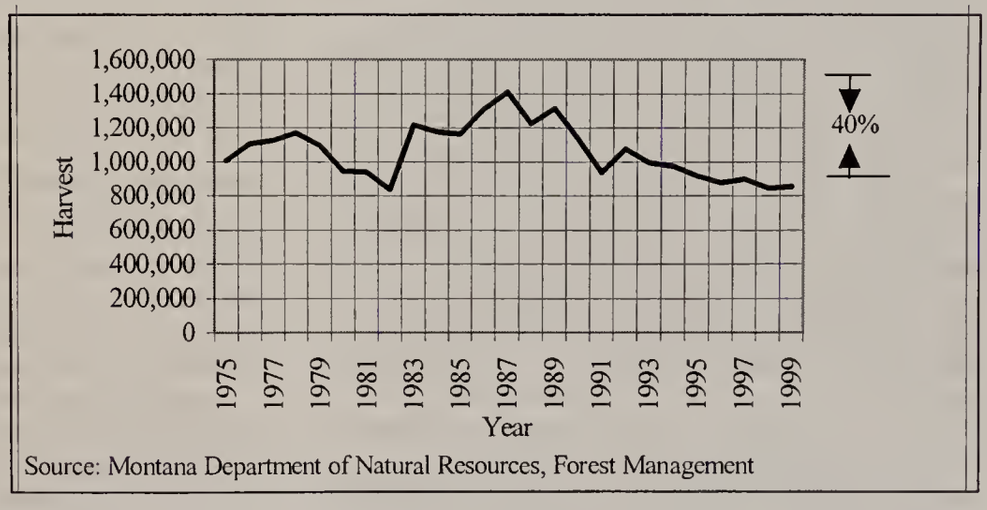
Timber-Related Employment

Timber harvesting generates employment. *Keegan et al* estimate that on average 10.58 jobs are created or maintained for every MMBF of timber harvested. Both economic theory and empirical analysis suggest that the marginal effect of an increase in the timber harvested is likely to be different than the average effect because of increasing returns. The marginal effect may be larger or smaller than the average. Empirical evidence would suggest that in a growing industry marginal effect on employment is likely to be smaller than the average. In a contracting industry, the marginal effect on employment could be either larger or smaller than the average. In most cases the marginal effect of increased or decreased timber sales is "lumpy", i.e. 2 sales of the same size under different conditions might induce a larger-than-average employment response in one case and a smaller-than-average, or nearly negligible, employment response in another.

FIGURE G-1 - TOTAL TIMBER HARVESTED FROM MONTANA FORESTS (MBF) demonstrates that the amount of timber being harvested in Montana from all sources has declined since 1987. The decrease in harvesting since the peak of 1,411 mmbf in 1987 has been nearly 40 percent to 854 mmbf in 1999. Mills, such as the Louisiana-Pacific Mill in Belgrade, recently closed, citing a lack of available timber as part of the cause of their closure. All of these point to an industry declining in size. Based on the previous discussion, the assumption of the average induced employment of 10.58 jobs per mmbf is reasonable. Because the exact conditions of this sale are unknown, the best estimate of employment, (i.e., the average effect on employment) should be used since it is the best estimate available and the marginal effect of the sale is unknown.

A ratio of 10.58 jobs per mmbf of wood harvested implies the direct generation of between 60 and 100 jobs and between $2.2 and $3.7 million in wages for each alternative as shown in *TABLE G-5 - WEST FORK I TIMBER SALE DIRECT EMPLOYMENT AND INCME IMPACTS*. The wages are based on an average wage of $37,347 for lumber industry in both counties, using the from data in *TABLE G-1—SELECTED DEMOGRAPHIC INFORMATION FOR FLATHEAD AND LINCOLN COUNTIES*. These are the wages that directly result from the timber harvest. Without a timber harvest, income would be lost to the State and communities. Wages in the timber industry are higher than

FIGURE G-1 - TOTAL TIMBER HARVESTED FROM MONTANA FORESTS (MBF)



Source: Montana Department of Natural Resources, Forest Management

TABLE G-5 - WEST FORK TIMBER SALE DIRECT EMPLOYMENT AND IMCOME IMPACTS

	ACTION ALTERNATIVE B	ACTION ALTERNATIVE C
Direct employment	100	60
Wages and salaries	$3,734,700	$2,240,800

average. This allows individuals working in the industry to obtain higher than average ownership of real personal property. Since much of the revenue for school funding comes from property taxation, higher levels of real property ownership should provide for better school funding.

In addition to these jobs, additional employment is created when the income earned within the timber industry is spent to purchase goods and services elsewhere in the economy. There are also impacts from the logging companies and timber mills when they purchase goods and services from the local economy. Both of these effects are important since they support other community businesses such as grocery and clothing stores, gas stations, etc. The loss of the income from this sale would mean not only the loss of the direct income, but the loss of the indirect income as well.

The economic impact on the schools occurs through ways other than just the direct contribution to the school trust fund from the revenue generated through timber sales. The timber industry pays taxes on the facilities it owns and operates. In the year 2000, the timber industry paid estimated taxes of over $848,600 to the schools in Flathead and Lincoln counties. The tax contribution, however, may decline in the future if more mills, such as American Timber Company in Flathead County, close. The closure of this mill has reduced the tax base by an estimated $4.4 million (*Jackson, South Wood Timber Sale EIS*), thereby reducing the taxes received by the school districts by about $28,500. This is a permanent reduction in school funding for over 4 students per year.

INDIRECT EFFECTS

Indirect economic impacts are much broader than those identified above. Some of these impacts are the result of the money from the timber sales "recycling" through the economy several times. For example, the money spent for groceries by the employee of the timber mill, in part, goes to pay the salary of the grocery store employees; the grocery store employees use that money to purchase groceries for themselves. This, in turn, generates more income for the grocery store employees, etc. Unfortunately, a model of the county that could be used to demonstrate secondary effects is not available. In a broader State-wide context, money paid to the woods industry workers results in increased State income tax collections as well as increased purchases in other areas of the State. Income tax collections from the wages of millworkers alone are estimated to generate between $87,000 and $146,000 in State tax revenue, depending on which alternative is selected. Taxes on indirect wages would add to this tax amount. Since State revenue is spent on projects State-wide, the entire State shares, in part, in the benefits that result from the timber sale. In particular, Montana schools benefit additionally by being able to use these revenues to fund schools throughout the State.

Nonmarket Issues

A quantitative analysis of the economic value of nonmarket benefits and costs will not be part of this analysis because they do not generate income for the trust, although they do affect the well-being of Montana residents. Because of their effects, a short qualitative discussion of nonmarket issues follows.

A brief description of the biological impacts is included in order to identify areas where economic values might be affected. A more detailed discussion of the biological impacts is found in other sections of the report.

Environmental Modifications - The harvest of the timber would modify

the undisturbed development of the forest and, as a result, would affect both the short- and long-term habitat and wildlife regimes. How individuals value these modifications is an empirical question and may be viewed either positively or negatively by different individuals. The estimation of the net social benefit or loss of the impacts described in this EIS is an empirical issue that does not directly affect the school trust fund.

Human Use - The harvest area has been historically used for recreational purposes such as hiking, hunting, and fishing. While the use of these areas is likely to decline or change during the period of logging, long-term overall use of the area is expected to remain high. Some nonmarket uses are unlikely to change. Fishing, for example, should not be severely affected by the logging since SMZ laws protect streams. The aesthetics would be modified; some individuals would view this as a loss, others may prefer the more-open forest that would result from the harvest. Visual changes are minimized to the extent practicable by limiting the trees harvested in some areas and by "sculpting cuts" to avoid "unnatural" visual lines. Some activities may be enhanced. For instance, the logged area may enhance the habitat of some game species, and the increased use of areas by those game species may make the area more attractive to hunters. As in the case of the environmental modifications, the net social benefit or loss is an empirical issue dependent on individual values.

Social Impacts

The area has a substantial presence in the wood-processing industry and, as a result, has institutions established to handle the social requirements associated with this industry. This timber sale is unlikely to add sufficient pressures to these institutions to require their modification. A high rate of employment (low rate of unemployment) is associated with lower rates of crime, domestic violence, alcohol/drug problems, and a healthier, more satisfied community. To the extent that No-Action Alternative A might contribute to unemployment, the social impact of the harvest might be a short-term negative social impact on the community. Conversely, to the extent that the sale provides employment, the short-term impact would be positive.

Roads and Infrastructure

New roads are to be constructed for the sale(s). Existing roads would be improved to handle the logging truck traffic and provide transport for other equipment used in logging. Expenditures for road improvements are identified in both action alternatives as part of the sale development cost. Some improvements are also funded through FI funds, as well as other funds set up for this purpose. To the extent that these expenditures are spent locally, they will improve local economic conditions. A portion of the money will leave the area and provide income for other areas of the State and national economies. The culverts, for example, usually come from manufacturers outside of Montana; however, most of the road improvement expenditures will remain in Montana.

Population Impacts

Logging and milling activities associated with the timber sale are not anticipated to have any long-term impact on the population of the region or the State of Montana.

CUMULATIVE EFFECTS

This sale would be part of the annual harvest of timber from the State of Montana forest trust lands. The net revenue from this sale would add to the trust fund. Annual trust

fund contributions have varied widely over the years, because the actual contribution to the trust is more a function of harvest levels than of sales. Harvest levels can vary substantially over time; sales tend to be more consistent. *TABLE G-6 - ANNUAL REVENUE FROM TIMBER HARVESTED FROM MONTANA TRUST LANDS* shows the annual revenue from harvesting for the last 5 years. The net contribution to the trust fund is also affected by the annual costs experienced by the Department for program management, which varies year to year. The Department should continue to make net annual contributions to the trust from its forest management program.

TABLE G-6 - ANNUAL REVENUE FROM TIMBER HARVESTED FROM MONTANA TRUST LANDS

YEAR	HARVEST REVENUE ($)
2003	8,270,589
2002	9,699,034
2001	8,524,150
2000	12,710,311
1999	6,998,847

DNRC has a State-wide sustained-yield annual harvest goal of 50 MMBF. If timber from this project is not sold, this volume could come from sales elsewhere; however, the timber may be from other areas and not benefit this region of the State. A long-term deferral of harvesting from this forest would impact harvest patterns, changing both the region where the trees are harvested and the volumes taken. This would impact other areas of the State where these changes occur.

Appendix H

Comments and Responses

APPENDIX H
COMMENTS AND RESPONSES

This section contains comments received from parties interested in the West Fork Timber Sale Project DEIS and DNRC's responses to those comments. A response is not required for those portions of the comments that stated either an opinion or a recommendation. All comments were carefully reviewed. DNLRC appreciates both the time and thought that was involved in producing these comments. The decisionmaker will carefully consider each received comment to aid him in deciding on a course of action for this project.

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Mr. McMahon,

These are comments on the Department of Natural Resource's (DNRC's) West Fork Swift Creek Timber Sale Project Draft Environmental Impact Statement (DEIS), on behalf of the Ecology Center and the Alliance for the Wild Rockies.

Our organizations appreciate the genuine ecosystem restoration activities proposed, such as removing deteriorating bridges and stream crossings, and improving drainage on existing roads.

As far as the logging, we don't believe that timber production is the best and highest use of school trust lands. Once again we have State land managers proposing to log public lands under the guise of generating funding for schools. Conventional "wisdom" has been that logging is the only way these lands can positively benefit our state and our school children. This notion is false. Witness the Sprunger-Whitney Nature Trail in the Swan Valley, which is a model for state land management. The trail will provide valuable educational resources that cannot be duplicated in the class-

While the State Forest Management Plan states that, "In the foreseeable future timber management will continue to be our primary source of revenue and our primary tool for achieving biodiversity objectives…" *(DEIS, Chapter I, page I-2)*, timber harvesting on Stillwater State Forest is not the exclusive action taking place that provides opportunities to the public and revenue to the school trusts. Many forms of recreation and education can, and do, take place in conjunction with timber-management activities. Stillwater Unit has provided opportunities for students ranging from elementary to college graduates to utilize the forest

room, and will also help pass down the importance of our state's natural heritage to our children for generations to come. We would also point you to economist Thomas Power's 1996 study of the State's forest management plan. Dr. Power's further reinforces that the DNRC's fundamental assumption that logging is the way to manage trust lands is seriously flawed.

So no, we don't believe that logging habitat for the threatened grizzly bear and Canada lynx, and the Endangered gray wolf, to be the highest and best use of the lands in this unique area. Nor do we believe that causing unwarranted sediment increases to degrade bull trout habitat in an already Water Quality Limited Segment to be a wise choice for out future. We believe that the DNRC is squandering an opportunity to educate citizens of the State of Montana and beyond about the ecological interrelationships and interplay between old-growth forests, fires, lynx, bears, hydrology, native fish—essentially the processes of a fully functioning ecosystem. Creating and providing an outdoor classroom for citizens to learn about the ecosystems in which they live, however subversive to the DNRC's rigid bureaucratic timber extraction paradigm, will absolutely contribute the most toward improving our dwindling chances of cultural survival.

We recommend that the DNRC analyze an alternative that is consistent with the Forest Restoration Principles and Criteria (DellaSala, et al., 2003). These principles have been developed and adapted by a number of conservation groups and forest practitioners across the nation.

for educational purposes and will continue to explore other ways to achieve this in the future. Forest-management activities also, in many ways, provide additional educational opportunities for students. During the public-comment period for this project, the initial proposal stated, "DNRC would consider other opportunities that would produce long-term revenue, meeting or exceeding that from any timber harvest that must be foregone." No specific proposals were received.

DNRC designs forest-management activities in a way that complies with the Federal Enabling Act designating State lands and their uses, Montana law governing State lands timber sales (*77-5-221-223 MCA*), and the Administrative Rules of Forest Management (*ARM 36.11.401* through *450*). The alternatives in this project were designed to meet the project objectives identified in the DEIS (*CHAPTER I, page I-2*) and address the issues that were identified through the scoping process. Restoration as a project objective exclusive of a timber sale project was not proposed or developed during project scoping.

Despite the Water Quality Limited Segment (WQLS) status of Swift Creek, the DEIS omits an alternative that would carry out only restoration activities and that wouldn't do more unnecessary damage. This is not reasonable. The DNRC must always include an alternative that removes or fixes all the roads having design flaws, are otherwise contributing to soil and watershed problems, or are not needed for foreseeable management activities. The citizens of our state need to know how much it will cost us to manage these watersheds correctly.

In project development, DNRC considered the improvements and restoration work needed to improve the BMP and water-quality status of the roads. Major aspects of these improvements are shown in the *DEIS, CHAPTER II - ALTERNATIVES, pages II-8 and II-9).* We have not developed a separate and unique alternative since this would be a different project requiring separate funding. The proposed project, in part, is a means to accomplish the identified work and also provide monetary return to the trust. As described in the *DEIS,* alternatives in this project were designed to meet project objectives identified in the *DEIS (CHAPTER I- PURPOSE AND NEED, page I-2)* and address the issues that were identified through the scoping process. Both action alternatives include roadwork *(DEIS, CHAPTER II—ALTERNATIVES, pages II-6 through II-8)* and mitigations *(DEIS, APPENDIX A - STIPULATIONS AND SPECIFICATIONS)* that address soil and watershed issues. Based on analysis of the scope and issues as the EIS was developed, no unresolved issues were identified that would have required the development of additional alternatives.

Since Swift Creek is a WQLS in regards to Clean Water Act and Montana water quality regulations, and a clean-up plan (TMDL) is to be prepared, the wisest course of action would be to prepare the TMDL for the needed restoration of the watershed, so that it can be determined when and if more logging can be consistent with the TMDL and the law.

The *DEIS* states that, "Under the Montana TMDL Law, new or expanded nonpoint-source activities affecting a listed waterbody may commence and continue provided they are conducted in accordance with all reasonable land, soil, and water conservation practices and BMPs." *(DEIS, page C-3)* DNRC is currently participating in the development of a TMDL and Water Quality Restoration Plan for Stillwater River (including Swift Creek) with Montana DEQ through the Swift Creek Coalition. Until the TMDL and Water Quality Restoration Plan are developed, DNRC will continue to comply with Montana law and apply all reasonable land, soil, and water conservation practices to forest-management activities.

The precision, or amount of error, in the modeled or otherwise estimated effects analysis estimates for measures of just about all resource conditions is not disclosed in the DEIS. The DEIS misrepresents them as precise measurements when in fact they are estimates, based upon limited sam-

Most of the figures in the *DEIS* are based on SLI data and mapping calculations. These estimates are based on single-point estimates or model outputs that do not have any measured variation. Where data was used to represent an average or mean, information on the precision of that estimate is incorporated in the *DEIS (eg. APPENDIX E—FISHERIES ANALYSIS, page E-12; APPENDIX*

pling or no sampling, that inherently has an amount of error. To illustrate what we're talking about refer to the U.S. Forest Service's "Response to Motion for Preliminary Injunction" brief in the ongoing litigation on the Kootenai National Forest. In regards to a scientific report, the Forest Service stated "Dr. Schloeder's purported 'statistical analysis' reports no confidence intervals, standard deviations or standard errors in association with its conclusions." The DNRC must be held to the same standards of data and information quality. However, the West Fork Swift Creek DEIS failed to present any "confidence intervals, standard deviations or standard errors in association with its conclusions" regarding the estimates or modeled effects analyses. Since the DEIS does not provide the public or decision maker with any kind of information on the accuracy of its estimates, the information is not scientifically valid nor reliable.

We don't believe the proposed management activities would severely hinder the *processes* that naturally shaped the ecosystem and resulted in a range of natural structural conditions. Generally, past process regimes are better understood than past forest structure. How are you factoring in fire, insects, tree diseases, and other natural disturbances in specifying the conditions you assume to be representative of the natural, historic range?

Many adverse consequences to soil, ecological processes, wildlife, and other elements of the natural environment are associated with logging. (Ercelawn, 1999; Ercelawn, 2000.) For example: "Salvage or thinning operations that remove dead or decayed trees or coarse woody debris on the ground will reduce the availability of forest structures used by fishers and lynx." (Bull et al., 2001.)

F–WILDLIFE ANALYSIS, page F-5).

The *Stand Development* section of the *DEIS* describes the effects site characteristics, environmental conditions, and past management activities have had on timber stands within the project area *(DEIS, APPENDIX B - VEGETATION ANALYSIS, pages B-6 through B-9* and *B-13 through B-15).* To determine representation of natural historic ranges, DNRC uses a coarse-filter approach *(ARM 36.11.404)* and models the desired future conditions for covertypes as described in *ARM 36.11.405;* see *DEIS, APPENDIX B - VEGETATION ANALYSIS, pages B-1 through B-4 and B-9 through B-11.*

The DEIS fails to provide maps of grizzly bear habitat that depict current core, during project core and post project core. Theses maps should include the roads layer and indications of which roads have fully effective road closures as well as the outline of road buffers that delineate core areas.

Maps of grizzly bear existing security core is mapped in the *DEIS (APPENDIX F—WILDLIFE ANALYSIS, page F-21, FIGURE F-5 - EXISTING FORESTED HABITAT IN THE UPPER WHITEFISH GRIZZLY BEAR SUBUNIT).*

The DEIS also fails to provide a genuine cumulative effects analysis if cumulative effects on grizzly bears in the affected recovery area, in conformance with scientific principles of analysis.

Cumulative effects on grizzly bears were conducted at the subunit scale. This is the scale of analysis recommended by the *Interagency Grizzly Bear Committee Task Force (IGBC 1998).*

The DEIS fails to discuss impacts on grizzly bear seasonal habitat. It has been well established in the scientific literature that of the seasonal habitats, spring range is the least available to bears due to high road densities in lower elevation habitat. The timing of den emergence and use of spring habitat is likely dependent on weather patterns, for example how long it takes for the snow pack to melt in higher elevation summer range. Another factor that should be considered is the quality of spring habitat: will it be or is it already highly fragmented? Are desirable spring forage plant species removed/destroyed as a result of logging? The grizzly bear analysis must consider these factors when gauging the impacts on grizzly bears.

Existing seasonal habitats are discussed in the *DEIS (APPENDIX F - WILDLIFE ANALYSIS, page F-17)*, and the effects of this project in relationship to those seasonal habitats are discussed on *pages F-20, F-23, and F-24.*

All roads opened for log hauling and other timber sale related traffic constitute an open road from a grizzly bears' perspective, regardless of whether or not "closed" to the public.

Roads used for hauling logs were considered as open roads and analyzed as such. Mitigations to offset increased open-road disturbance were described and analyzed in the *DEIS (APPENDIX F - WILDLIFE ANALYSIS, pages F-20 through F-24.* Prohibiting public use on currently restricted roads that would be used for harvesting timber and prohibiting contractors from carrying firearms would maintain security for grizzly bears in these areas *(DEIS, APPENDIX F - WILDLIFE ANALYSIS , pages F-22* and *F-24).*

The DEIS does not address the recent proliferation of recreational motorized access (ATVs, motorcycles, snowmobiles) and the potential to increase that use in the project

area.

The DNRC so often makes a case for logging as a way to reduce insect and disease damage to timber stands. As far as we are aware, the DNRC has no empirical evidence to indicate its "treatments" for "forest health" decrease, rather than increase, the incidence of insects and diseases in the forest. "Forest health" discussions are unscientific and biased toward logging as a "solution."

The DEIS blames the lack of soil scarification for the "problem" of only spruce and subalpine fir (III-6 and 7). Ecosystems are so complex, with innumerable interrelated structures and functions, we wonder how the DNRC can pinpoint regeneration problems onto too little heavy machinery use, rather than too much. Please consider the large body of research that indicates logging, roads, and other human caused disturbance promote the spread of tree diseases and insect infestation.

For example, multiple studies have shown that annosus root disease (Heterobasidion annosum, formerly named Fomes annosus), a fungal root pathogen that is often fatal or damaging for pine, fir, and hemlock in western forests, has increased in western forests as a result of logging (Smith 1989). And researchers have noted that the incidence of annosus root disease in true fir and ponderosa pine stands increased with the number of logging entries (Goheen and Goheen 1989). Large stumps served as infection foci for the stands, although significant mortality was not obvious until 10 to 15 years after logging (Id.).

The proportion of western hemlock trees infected by anno-

Complete removal of insect or disease problems from the forest, which is neither possible or practical, is not the intention of this project. One objective of the project is to improve the long-term productivity of timber stands by increasing stand vigor, reducing the incidence of insect infestations and disease infections, and regenerating portions of stands where timber-stand growth is decreasing *(DEIS, CHAPTER I - ALTERNATIVES, page I-2)*.

An evaluation of the insect and disease conditions in the project area identified specific pathogens and determined that their effects are not severe *(DEIS, APPENDIX B - VEGETATION ANALYSIS, page B-7)*. Risks associated with taking silvicultural actions or not are assessed during project development. One of the risks assessed is loss of volume, value, and vigor of the timber on site if no action is taken at this time.

To assess the risks, we regularly consult with the professional literature, as well as entomologists and pathologists, to determine prudent courses of action for proposed projects. The proposed silvicultural prescriptions would limit the incidence of insects and disease problems by:

- identifying trees that are already infected by pathogens and infested by insects and salvaging their stumpage value;
- limiting the extent and season of machine use to reduce damage to the remaining trees *(DEIS, APPENDIX D - SOILS ANALYSIS, page D-1 to D-3)*;
- retaining disease-resistant/tolerant tree species, including western larch, Douglas-fir, and rust-resistant western white pine, in partially harvested stands *(DEIS, CHAPTER II - ALTERNATIVES, page II-10 to II-12)*;
- replanting with disease-resistant tree species in regeneration harvest units *(DEIS, CHAPTER II - ALTERNATIVES, page II-10 to II-12, and APPENDIX B - VEGETATION ANALYSIS, page B-13 and B-14)*; and

sus root disease increased after precommercial thinning, due to infection of stumps and logging equipment wounds (Edmonds et al. 1989, Chavez, et al. 1980).

Armillaria, a primary, aggressive root pathogen of pines, true firs, and Douglas-fir in western interior forests, spreads into healthy stands from the stumps and roots of cut trees (Wargo and Shaw 1985). The fungus colonizes stumps and roots of cut trees, then spreads to adjacent healthy trees. Roots of large trees in particular can support the fungus for many years because they are moist and large enough for the fungus to survive, and disease centers can expand to several hectares in size, with greater than 25% of the trees affected in a stand (id.). Roth et al. (1980) also noted that Armillaria was present in stumps of old-growth ponderosa pine logged up to 35 years earlier, with the oldest stumps having the highest rate of infection.

Filip (1979) observed that mortality of saplings was significantly correlated to the number of Douglas-fir stumps infected with Armillaria mellea and laminated root rot (Phellinus weirii). McDonald, et al. (1987) concluded the pathogenic fungus Armillaria had a threefold higher occurrence on disturbed plots compared to pristine plots at high productivity sites in the Northern Rockies. Those authors also reviewed past studies on Armillaria, noting a clear link between management and the severity of Armillaria-caused disease.

Morrison and Mallett (1996) observed that infection and mortality from the root disease Armillaria ostoyae was several times higher in forest stands with logging disturbance than in undisturbed stands, and that adjacent residual trees

- improving vigor of residual trees by reducing competition from infected trees and allowing more moisture and sunlight to reach the remaining trees *(DEIS, APPENDIX B - VEGETATION ANALYSIS, page B-14, and DEIS, CHAPTER II - ALTERNATIVES, page II-10* through *II-11)*.

as well as new regeneration became infected when their roots came into contact with roots from infected stumps.

Precommercial thinning and soil disturbance led to an increased risk of infection and mortality by black-stain root disease (Leptographium wageneri) in Douglas-fir, with the majority of infection centers being close to roads and skid trails (Hansen et al. 1988). Also another Black-stain root disease (Verticicladiella wagenerii) occurred at a greater frequency in Douglas-fir trees close to roads than in trees located 25 m or more from roads (Hansen 1978). Witcosky et al. (1986) also noted that precommercially thinned stands attracted a greater number of black-stain root disease insect vectors.

Complex interactions involve mechanical damage from logging, infestation by root diseases, and attacks by insects. Aho et al. (1987) saw that mechanical wounding of grand fir and white fir by logging equipment activated dormant decay fungi, including the Indian paint fungus (Echinodontium tinctorium).

Trees stressed by logging, and therefore more susceptible to root diseases are, in turn, more susceptible to attack by insects. Goheen and Hansen (1993) reviewed the association between pathogenic fungi and bark beetles in coniferous forests, noting that root disease fungi predispose some conifer species to bark beetle attack and/or help maintain endemic populations of bark beetles.

Goheen and Hansen (1993) observed that live trees infected with Laminated root rot (Phellinus weirii) have a greater likelihood of attack by Douglas-fir beetles (Dendroctonus

pseudotsugae). Also, Douglas-fir trees weakened by Black-stain root disease (Leptographium wageneri var. pseudotsugae) are attacked and killed by a variety of bark beetle species, including the Douglas-fir bark beetle (D. pseudotsugae) and the Douglas-fir engraver (Scolytus unispinosis) (id.).

The root disease Leptographium wageneri var. ponderosum predisposes ponderosa pine to several bark beetle species, including the mountain pine beetle (D. ponderosae) and the western pine beetle (D. brevicomis) (Goheen and Hansen 1993).

A variety of root diseases, including black-stain, Armillaria, and brown cubical butt rot (Phaeolus schweinitzii), predispose lodgepole pine to attack by mountain pine beetles in the interior west. The diseases are also believed to provide stressed host trees that help maintain endemic populations of mountain pine beetle or trigger population increases at the start of an outbreak (Goheen and Hansen 1993).

Grand and white fir trees in interior mixed-conifer forests have been found to have a high likelihood of attack by the fir engraver (Scolytus ventralis) when they are infected by root diseases, such as laminated root rot, Armillaria, and annosus (Goheen and Hansen 1993).

More western pine beetles (Dendroctonus breviformis) and mountain pine beetles (D. ponderosae) were captured on trees infected by black-stain root disease (Ceratocystis wageneri) than on uninfected trees (Goheen et al. 1985). The two species of beetle were more frequently attracted to wounds on trees that were also diseased than to uninfected trees.

They also noted that the red turpentine beetle (Dendroctonus valens) attacked trees at wounds, with attack rates seven-to-eight times higher on trees infected with black-stain root disease than uninfected trees. Spondylis upiformis attacked only wounded trees, not unwounded trees (Id.).

Any contentions that potential insects and tree diseases in the project area would be something to be concerned about ecologically runs counter to more enlightened thinking on such matters. For example, Harvey et al. 1994 state:

> **Although usually viewed as pests at the tree and stand scale, insects and disease organisms perform functions on a broader scale.**
>
> **...Pests are a part of even the healthiest eastside ecosystems. Pest roles—such as the removal of poorly adapted individuals, accelerated decomposition, and reduced stand density—may be critical to rapid ecosystem adjustment**
>
> **...In some areas of the eastside and Blue Mountain forests, at least, the ecosystem has been altered, setting the stage for high pest activity (Gast and others, 1991). This increased activity does not mean that the ecosystem is broken or dying; rather, it is demonstrating functionality, as programmed during its developmental (evolutionary) history. (Emphasis added.)**

The DEIS fails to disclose how much forest—including old growth, by type, has been clearcut, salvaged, intermediate cut, thinned, etc. in the analysis area. This makes the cumulative effects discussion of vegetative conditions of little value.

DNRC's discussion on the coarse-filter approach to forest covertypes and age classes is based on an existing condition and the modeling of SLI data *(STW 2003 SLI)*; past harvests and management activities are included in the SLI data, as well as in the coarse-filter analysis (see *DEIS, APPENDIX B - VEGETATION ANALYSIS, under ANALYSIS METHODS, COVERTYPE, AND AGE CLASSES)*. DNRC's SLI includes periodic annual harvest updates.

The cumulative effects analysis is largely a listing of projects, there is no meaningful analysis of how all activities have affected or will affect wildlife, fish, water quality, soils, or any resource. It is important that the results of past project-level and programmatic plan-level monitoring be incorporated into project-level analysis. In order for a cumulative effects analysis to be sufficient, the following must be included in an EIS:

- **A list of all past projects (completed or ongoing) implemented.**
- **An integrated discussion of those projects' impacts on the resources potentially affected by the proposed action.**
- **The results of all monitoring done in the project areas as committed to in the MEPA documents of those past projects.**
- **A description of any monitoring, specified in those past project MEPA documents for those past projects, which has yet to be gathered and/or reported.**
- **A discussion of how all those projects did, or did not, meet objectives and the needs for which the projects were designed.**

Cumulative effects were considered for the applicable resources throughout the effects analysis. The *DEIS* describes the cumulative effects analysis for wildlife *(APPENDIX F - WILDLIFE ANALYSIS)*, fisheries *(APPENDIX E - FISHERIES ANALYSIS)*, water quality *(APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS)*, and soils *(APPENDIX D - SOILS ANALYSIS)*. Effects from past projects are incorporated into DNRC databases over time and become part of the existing condition that is used in each analysis *(see DEIS, CHAPTER III - EXISTING ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES, page III-1)*. *Ongoing and proposed projects are considered for each resource based on the appropriate analysis area (see CHAPTER I - PURPOSE AND NEED, page I-3)*. This project was designed and would be implemented in accordance with the *Administrative Rules of Montana* for forest management, which include project-level and programmatic monitoring and reporting requirements *(ARM 36.11.448)*. Monitoring results are incorporated into management direction over time. Project design, including stipulations and specifications, is based on that guidance.

The DNRC has failed to evaluate or define a landscape program for old-growth habitat, and in effect, thus plan for the long term viability of old-growth associated wildlife, prior to extensive logging of old-growth habitat. As a result, the cumulative impacts of existing levels of old growth and distribution in the analysis area are never evaluated. Yet existing and planned landscape distribution of old growth will be key to many associated species, including the pine marten, pileated woodpecker, northern goshawk, fisher, boreal owl,

DNRC conducts a cumulative effects analysis for old growth in each project that proposes to harvest in old growth; the methods are described in the *DEIS (APPENDIX B - VEGETATION ANALYSIS, page B-2)*. The Department made no viability analysis requirements in either the *SFLMP* or *ARM*. Analysis of old growth on Stillwater Unit, in accordance with the general direction provided by *ARM*, suggest that the amounts of old growth currently on Stillwater Unit's landscape are not outside of a historical range of variation.

great gray owl, flammulated owl, and black-backed woodpecker since they require large blocks of high quality old growth. Logging of small fragmented old growth will possibly limit recovery of landscape distributions of old growth to required densities for some or all of these species.

The DNRC has failed to complete an adequate assessment of logging impacts on sensitive wildlife associated with old growth. The analysis draws conclusions without any demonstration that landscape densities and quality of old growth are currently adequate for these species.

Juday (1978) discusses in detail how the protection of old-growth forests greatly sustains the many uses of our national forests, as mandated by federal laws. As interest in intrinsic and ecosystem values of old-growth forests on State lands grows, as plainly evidenced in recent years, these values will be best met by preserving and protecting all old growth values Juday identified. Instead, Alternative B proposes to obliterate the largest unfragmented block of old growth remaining in the Stillwater State Forest.

The DEIS fails to provide an adequate definition of old-growth habitat. The DNRC has failed to clearly define what old growth is as per specific criteria, or how these criteria will be affected with the proposed logging.

What specific criteria for old growth have been used to

Through a patch analysis of old-growth stands, at least 6 other larger continuous blocks of old growth are located on Stillwater State Forest.

See the *DEIS GLOSSARY (page 4, 'Old growth')*. *Also see DEIS, APPENDIX B - VEGETATION ANALYSIS (page B-11, Direct Effects of Action alternative B to Old-Growth Distribution and Attributes)*, which states "The posttreatment timber stand would no longer meet DNRC's criteria for old growth." *CHAPTER II - ALTERNATIVES (pages II-12 and II-13)* describes that those areas of old-growth would receive a regeneration harvest, and existing snags and an average of 1 live large-diameter tree per acre would be retained.

identify old growth stands in the project and analysis area? We would like to know these criteria for average number of large trees per acre, the minimum dbh of these large trees, the minimum age of large trees, the average basal area for the stand, the average snags per acre over 9 inches dbh, the average number of trees over 9 inches dbh with broken tops, and the average percent of trees greater than 9 inches dbh showing decay.

Have all stands been evaluated according to the above criteria? If not, how has old growth been identified?

How do your criteria for old growth compare to those defined by Region 1 of the Forest Service for old growth on the Kootenai National Forest? Specifically, what Old Growth Type Codes defined by Region 1 occur in the project area?

The DEIS fails to demonstrate that the proposed activities would be in compliance with all of the State Programmatic Plan old-growth and wildlife standards. Similarly, the DEIS's analyses for old-growth dependent wildlife species makes no connection between the areas designated for old-growth management and old-growth wildlife species. The existing amounts, block sizes, connectivity, spatial relationships, and integrity free from edge effects and fragmentation are not at all related to old-growth wildlife species' habitat needs, and thus viability.

As noted above, the DNRC definition of old growth are those stands having the minimum number of trees per acre that have a minimum dbh and a minimum age for a given site. These minimums are listed in *Old Growth Forest types of the Northern Region (Green et al 1992)*, although some minor adaptations have been made due to data compatibility. Within the Stillwater Unit Analysis Area, *STW 2003 SLI* data was reviewed. Models within the SLI identify stands that have the potential of meeting the old-growth definition. Within proposed project areas, field verification is conducted, which can be either reconnaissance surveys or plot surveys. Information gathered would update or change SLI data such as habitat types, live trees per acre, age of overstory, number and size of snags, etc.

As noted in the *DEIS (APPENDIX B - VEGETATION ANALYSIS, page B-6)* 95 percent of the project area acreage is in the "cool and moist" habitat group. Of the 777 acres of old growth identified in the project area, approximately 736 acres are located in cool and moist habitat types (Habitat Type Group E), which requires that 10 trees per acre that are 21 inches dbh or greater and at least 180 years old be present to be labeled as old growth. The other 41 acres of old growth are located in a cool and moderately dry habitat group (Habitat Type Group G) that requires an average 10 trees per acre 17 inches dbh or greater and 180 years old be present to be labeled as old growth.

DNRC developed the project under the philosophies of the SFLMP and has designed the alternatives to meet the SFLM Rules for Biodiversity, including Old-Growth Management, and for the various wildlife species noted in the *DEIS*.

Forest-habitat fragmentation was analyzed in the *DEIS, APPENDIX F - WILDLIFE ANALYSIS (pages F-2 and F-7, under COARSE-FILTER ASSESSMENT)* and the effects to specific threatened, sensitive, and big game species were discussed under the species heading *FINE-FILTER ASSESSMENT*. Since DNRC lands comprise a small portion of the landscape, the species viability analysis is beyond the scope of the wildlife analysis.

As far as we're aware, the state has never specified the amount and distribution of habitat necessary to maintain viable populations of these species. Nor has it gathered any data on population trends of these species.

USDA Forest Service (2004a) discusses the value of small patches of old-growth habitat and cites scientific studies and lists many adverse impacts from fragmentation of old growth habitat:

> Harvesting or burning adjacent to old growth can remove the edge buffer, reducing the effective size of old growth stands by altering interior habitats (Russell and Jones 2001). Weather-related effects have been found to penetrate over 165 feet into a stand; the invasion of exotic plants and penetration by predators and nest parasites may extend 1500 feet or more (Lidicker and Koenig 1996).
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> ...Harvest or burning in stands immediately adjacent to old growth mostly has negative effects on old growth, but may have some positive effects. Harvesting or burning adjacent to old growth can remove the edge buffer, reducing the effective size of old growth stands by altering interior habitats (Russell and Jones 2001). Weather-related effects have been found to penetrate over 165 feet into a stand; the invasion of exotic plants and penetration by predators and nest parasites may extend 1500 feet or more (Lidicker and Koenig 1996).
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> ... The occurrence of roads can cause substantial edge effects on forested stands, sometimes more than the harvest areas they access (Reed, et al. 1996; Bate and Wisdom, in prep.). Roads that are open to the public expose many

DNRC rarely collects data on population levels; however, we do participate in interagency efforts to collect such data. DNRC ownership represents a small portion of the landscape. Due to the limited contribution these lands provide, DNRC focuses on more localized effects at a scale of a species' home range. DNRC bases the analysis on habitat parameters, not population levels.

important wildlife habitat features in old growth and other forested stands to loss through firewood gathering and increased fire risk.

Effects of disturbance also vary at the landscape level. Conversion from one stand condition to another can be detrimental to some old growth associated species if amounts of their preferred habitat are at or near threshold levels or dominated by linear patch shapes and limited interconnectedness (Keller and Anderson 1992). Reducing the block sizes of many later-seral/structural stage patches can further fragment existing and future old growth habitat (Richards et al. 2002). Depending on landscape position and extent, harvest or fire can remove forested cover that provides habitat linkages that appear to be "key components in metapopulation functioning" for numerous species (Lidicker and Koenig 1996, Witmer et al. 1998).

The DNRC must maintain enough old-growth habitat for decades to come on the Stillwater State Forest. There are no solid data on how much old-growth forest existed before logging nor what the normal historical ranges have been. The DEIS provides no information on how much has been logged or lost due to road building, wildland fire, or simple forest succession. There is no discussion as to the impacts of this cumulative loss of old growth on wildlife species. And there is no disclosure on how much effective old growth is expected to be lost in the future due to these effects.

As stated, there is no estimate of how much forest would have historically met DNRC's current restrictive definition of old growth. Several approaches estimate historic or naturally occurring amounts of stands with older-aged trees, but these approaches were not addressed in this DEIS. Prior to adoption of the *SFLM Rules* in 2003, comparisons were made and displayed that Stillwater Unit was within naturally occurring levels of Older Stands or stands where the primary age class was greater than 150 years.

In 2000, Stillwater Unit was estimated to have approximately 32 percent of its land base in Old Stand status, and based on modeling of *Flathead National Forest's Amendment 21*, Stillwater Unit had an estimated 29 percent of its land base in a late seral stage *(DNRC 2000)*. Based on *STW 2003 SLI* data, 48 percent of Stillwater Unit's forested landbase is over 150 years old *(DEIS, APPENDIX B - VEGETATION ANALYSIS, page B-4)*.

DNRC discussed the effects of the proposed harvest (not only old growth) at the project and landscape scale *(DEIS, APPENDIX F - WILDLIFE ANALYSIS, pages F-2, F-3, and F-7)*. DNRC considered the existing condition (which includes past harvests and other disturbances) and potential cumulative effects of known proposed future actions in this analysis.

USDA Forest Service (1999a) discussed the relationship between wildlife species and the habitat components found only in mature an old growth forests:

> Fishers occur most commonly in landscapes dominated by mature to old-forest cover." (III-254.) "Fishers prefer habitats with high canopy closure (greater than 80 percent) and avoid areas with low canopy closure (less than 50 percent). ...The habitat requirements of fishers are thought to be associated with the physical structure of the forest and associated prey. This structure includes the vertical and horizontal complexity created by a diversity of trees sizes and shapes, light gaps, dead and downed wood and layers of overhead cover. Large-diameter spruce and grand-fir snags and large downed material are used for denning and foraging. Fishers tend to avoid non-forested areas. (III-254.)

> Many wildlife species occurring on the IPNF prefer or only occur in mature and old-growth forests. Mature and old forests are more likely than younger forests to provide habitat for species which prefer large trees, structural and biological diversity, and closed canopies, and/or which depend on snags or down logs for nesting, foraging or raising their young. (Id. at III-243.)

> Over 40 wildlife species depend on snags (dead trees) for their forage, cover or a place to raise their young. (III-244.)

> Existing structurally immature stands could provide old-growth habitat over time if not disturbed or if managed to maintain large, old, diseased and dead structural components of the forest within the levels needed to provide suitable habitat. (III-243.)

> Most species identified as "Sensitive" by the Forest Service are associated with later successional habitats, or habitat and cover types in short supply (such as cottonwood communities, large standing dead trees or large downed trees.). (III-244.)

> Large-diameter snags provide habitat for the greatest variety of cavity users and remain standing longer than smaller snags. (III-244.)

> Snags provide den sites for fishers and other mammals, and roosts for

several species of bats and owls. (III-244.)

Goshawks have habitat requirements associated with components and attributes of late successional forests. While associated with mature to old growth habitat, they utilize other successional stages. For example, feeding habitat can be found in pole-sized timber stands. …Old growth is important for northern goshawks not only for prey species habitat but also for the large trees that provide the substrate for their substantial nest structures. (III-255.)

In the western United Stares, marten are most abundant in mature to old-growth true-fir or spruce-fir forests and generally avoid open, drier coniferous forest. They prefer forest stands greater than 40 percent tree canopy closure, which protects them from predators and enhances the moist conditions favorable for prey species. (III-257.)

Marten are closely associated with mature to old-growth timber stands, preferring moist habitat types where small mammals are more abundant. American marten prefer stands with greater than 40 percent canopy closure, and tend to avoid those stands with less than 30 percent closure. In addition to a closed canopy, marten require an abundance of large downed logs and snags. This provided secure resting locations, denning habitat and winter access to small mammals living beneath the snow. (III-580, 581.)

Pileated Woodpecker. This species nests and roosts in cavities in large diameter (20 inches diameter or greater) live or dead trees. It selects nest trees in clumps of snags in stands with at least 70% canopy cover. …Pileated woodpeckers feed on beetles, carpenter ants and other insects in live and dead trees, logs and stumps. (III-258.)

The DNRC has failed to cite any evidence that its managing for old growth habitat (i.e., logging and burning old growth) strategy will improve old-growth wildlife species' habitats over the short-term or long-term. In regards to this popular DNRC theory:

> **(T)here is the question of the appropriateness of management manipulation of old-growth stands… Opinions of well-qualified experts vary in this regard. As long term results from active management lie in the future – likely quite far in the future – considering such ma-**

DNRC does not claim that managing old growth in this project will improve habitat conditions. In the short term, old-growth habitat would decrease. In the distant long term, a new stand with a different composition of tree species would regenerate to

nipulation as appropriate and relatively certain to yield anticipated results is an informed guess at best and, therefore, encompasses some unknown level of risk. In other words, producing "old-growth" habitat through active management is an untested hypothesis.
(Pfister et al., 2000, pp. 11, 15 emphasis added).

Lesica (1995) stated that maintaining 10% of forest landscapes as old growth may result in extirpation of some wildlife species. This is based on his estimate that 20-50% of low and many mid-elevation forests were in old growth condition prior to European settlement.

USDA Forest Service, 2004a at page 3-199 states:

Across the Interior Columbia River Basin (Quigley, et al. 1996), old forests have declined by 27 to 60 percent over that past 100 years and large residual trees and snags have decreased by 20 percent. Fire exclusion and timber harvest have altered the structure and composition of forests throughout the Basin, resulting in a 60 percent increase in susceptibility to insects, disease, and stand-replacing fires. These changes have contributed to declining habitat conditions for numerous species of wildlife associated with old growth forests.

The Stillwater State Forest is home for Canada lynx, listed as a Threatened species under the Endangered Species Act (ESA). The DEIS fails to adequately address the effects of logging on landscape pattern, which is essential for designation of critical habitat for the Canada lynx. The Lynx Conservation Assessment and Strategy (LCAS—as cited in the DEIS) require that federal actions must:

Maintain suitable acres and juxtaposition of lynx habitat through time. Design vegetation treatments to approximate historical landscape patterns and disturbance processes.

potentially provide habitat. Based on the composition changes in tree species, DNRC expects future stands to include a higher density of shade-intolerant tree species. The presence and increased representation of these tree species is expected to benefit species that use deadwood in the future.

The *DEIS* discussed the current landscape patterns and the effects to those patterns in the coarse-filter analysis *(DEIS, APPENDIX F - WILDLIFE ANALYSIS, pages F-2, F-3,* and *F-7).*

If the landscape has been fragmented by past management activities that reduced the quality of lynx habitat, adjust management practices to produce forest composition, structure, and patterns more similar to those that would have occurred under historical disturbance regimes.

The LCAS sets Standards, which include:

Identify key linkage areas that may be important in providing landscape connectivity within and between geographic areas, across all ownerships. (LCAS at 89.)

Develop and implement a plan to protect key linkage areas on federal lands from activities that would create barriers to movement. Barriers could result from an accumulation of incremental projects, as opposed to any one project. (Id.)

Map and monitor the location and intensity of snow compacting activities that coincide with lynx habitat, to facilitate future evaluation of effects on lynx as information becomes available. (LCAS at 83.)On federal lands in lynx habitat, allow no net increase in groomed or designated over-the-snow routes and snowmobile play areas by LAU.

Among the standards set out in the LCAS are provisions to maintain denning habitat as discussed in the programmatic lynx BO:

Denning Habitat - Within developmental land allocations, existing Plan direction to maintain old growth habitat was judged to be adequate to provide for lynx denning habitat for all geographic areas except the Great Lakes. (BO at 31.)

The DEIS does not disclose how the loss of lynx habitat is consistent with scientific lynx management. In fact, the DEIS proposes a "taking" of lynx, an action prohibited under the Endagnered Species Act.

The *FEIS* incorporates lynx habitat estimations that were not reported in the *DEIS*. DNRC did not adopt the guidelines in the *Lynx Conservation Assessment and Strategy* to manage effects to lynx habitat. All alternatives meet the *ARM*, which DNRC is legally obligated to meet; they also meet the *Lynx Conservation Assessment and Strategy* thresholds for temporarily unsuitable habitat.

The impacts of both winter and non-winter motorized route densities have not been adequately considered. The LCAS states, "the effects of open road densities on lynx are poorly understood" (LCAS at 95). It is not clear that the DNRC has a complete understanding of the current level of use of the project area for snowmobiles. Moreover, the DEIS fails to disclose the expected level of cumulative impacts on lynx from the additional new roads, additional skid trails, and other logging access routes to be constructed in the project area—roads/access routes that could be used by snowmobilers, snowshoers, and cross country skiers long after the logging activities have stopped. These roads/access routes can also impact lynx habitat during other seasons because of increased access for humans.

These effects were discussed in the *DEIS (APPENDIX F - WILDLIFE ANALYSIS, page F-14.*

From Ruggiero, et al. (1999, p. 24): "Lynx metapopulation dynamics operate at regional scales." Lacking maps and adequate discussion of the connectivity issue in the DEIS, it is impossible to see the landscape features that affect connectivity and metapopulation dynamics within and outside the project area.

The *DEIS* discussed forest connectivity on forest-dwelling species, such as Canada lynx, in the coarse-filter analysis *(DEIS, APPENDIX F - WILDLIFE ANALYSIS, pages F-3 and F-7)* and provided *FIGURE F-1 - EXISTING FORESTED HABITAT IN THE UPPER WHITEFISH GRIZZLY BEAR SUBUNIT* to depict forest connectivity.

Ruggiero, et al. 1994 provide guidance for reconciling the disparity between the geographic size of project analyses vs. the needs of species: "The disparity between the scale of a local

management action (e.g., a timber sale) and the scale of the ecological response (e.g., species viability) is a fundamental problem in assessing population viability."

Both Ruggiero, et al. 1994 and Lindenmayer, et al. 1993 provide discussion on why population viability analysis is the best available tool assessing population viability, the latter providing examples of population viability analysis being used for several species of wildlife and one plant species. Lacy and Clark, 1993 provide an example of population viability analysis used to design a computer simulation of risk of extinction of the pine marten.

In a scientific document prepared as a part of ICBEMP, Witmer, Martin, & Sayler (1998) make recommendations which reinforce our comments about population dynamics, population viability analysis, and monitoring. From the Abstract:

> Forest carnivores in the Pacific Northwest include 11 medium- to large-sized mammalian species of canids, felids, mustelids, and ursids. These carnivores have widely differing status in the region, with some harvested in regulated furbearer seasons, some taken for depredations, and some protected because of rarity. Most large carnivores have declined in numbers or range from human encroachment, loss or modification of forest habitat, accidental deaths (e.g., mortality from vehicles), illegal kills, and our inability to adequately monitor and protect populations. Efforts to reverse these trends include new approaches to reduce conflicts with humans, research to better define habitat needs, formation of expert carnivore working groups, and use of Geographic Information System

models to predict specific impacts of habitat modifications. Long-term preservation of large carnivores in the region is problematic unless we reduce forest fragmentation and conflicts with humans and improve our ability to quantitatively integrate population dynamics with landscape level habitat requirements. (Emphasis added.)

The issue of providing for the larger landscape needs of far-ranging forest carnivores (including the grizzly bear, gray wolf, wolverine, fisher, pine marten, lynx, goshawk, etc.) reveals the need to utilize the principles of Conservation Biology on a landscape level. Core areas of relatively undisturbed habitats need to be maintained. Linkages with other core areas need to be established, providing sufficient habitat components so the linkages, or corridors, are functional for genetic interchange purposes. Both core areas and linkages should be the focus of the watershed rehabilitation and recovery discussed above (such as road removal). Buffer zones around core areas should also be recognized in their contribution to habitat needs for these wildlife species.

State-of-the-art conservation biology principles require an increasing focus on the landscape-scale concept and design of large biological reserves accompanied by buffer zones and habitat connectors as the most effective (and perhaps only) way to preserve wildlife diversity and viability (Noss, 1993).

Cumulative effects on old-growth habitat and on old-growth associated species include increased fragmentation, reduced older forest patch sizes, increased high-contrast edge, reduced availability of interior habitat, and decreased forested connectivity. Forest fragmentation is a major ongo-

These figures are displayed in the *DEIS (APPENDIX F - WILDLIFE ANALYSIS, page F-3, TABLE F-2 - EXISTING AND RESULTING ACRES OF FORESTED, INTERIOR, AND EDGE HABITAT ON THE UPPER WHITEFISH GRIZZLY BEAR SUBUNIT).*

ing concern. It is documented that edge effects occur 10-30 meters into a forest tract (Wilcove et al., 1986). The size of blocks of interior mature and old-growth forest that existed historically before management (including fire suppression) was initiated must be compared to the present condition. The DEIS fails to disclose the degree to which edge effects on old growth species' habitat exist, and how much total edge effect would be increased, by the alternatives. Such effects would reduce the ability to provide for the habitat needs of old-growth associated species for decades to come following implementation of the project and other activities in the watershed.

Mills (1994) points out the necessity of considering habitat fragmentation and current landscape pattern, caused by past logging and road building, for wildlife movements and therefore viability. Mills points out that the FS's use of the term "viable" refers to habitat characteristics, not population dynamics. Mills goes on to explain the range of parameters that must be used to make a scientifically sound assessment of the viability of wildlife species. Population dynamics refers to persistence of a population over time—which is key to making predictions about population viability. Population dynamics include assessing population size, population growth rate, and linkages to other populations and must be included in a scientifically sound Population Viability Analysis (hereafter "PVA"). Ruggiero, et. al. (1994) also point out that a sound PVA must utilize measures of population dynamics. Also, temporal considerations of the impacts on wildlife population viability must be considered (id.) but this has never been done by the DNRC. It is also of paramount importance to monitor population trends in order to validate assumptions used about long-term species persistence i.e., population viability (Marcot and Murphy, 1992; Lacy and

Clark, 1993).

USDA Forest Service (2004a) states:

> Forested connections between old growth patches …(widths) are important because effective corridors should be wide enough to "contain a band of habitat unscathed by edge effects" relevant to species that rarely venture out of their preferred habitats (Lidicker and Koenig 1996 and Exhibit Q-17). (Page 3-201.)
>
> Timber harvest patterns across the Interior Columbia River basin of eastern Washington and Oregon, Idaho, and western Montana have caused an increase in fragmentation of forested lands and a loss of connectivity within and between blocks of habitat. This has isolated some wildlife habitats and reduced the ability of some wildlife populations to move across the landscape, resulting in long-term loss of genetic interchange (Lesica 1996, U.S. Forest Service and Bureau of Land Management 1996 and 1997). (Page 3-216.)

USDA Forest Service (2004a) discusses the fragmentation effects on old-growth habitat, effects that would be exacerbated by the project without consideration of fragmentation effects on viability in the DEIS:

> Harvest or burning in stands immediately adjacent to old growth mostly has negative effects on old growth, but may have some positive effects. Harvesting or burning adjacent to old growth can remove the edge buffer, reducing the effective size of old growth stands by altering interior habitats (Russell and Jones 2001). Weather-related effects have been found to penetrate over 165 feet into a stand; the invasion of exotic plants and penetration by predators and

nest parasites may extend 1500 feet or more (Lidicker and Koenig 1996). On the other hand, adjacent management can accelerate regeneration and sometimes increase the diversity of future buffering canopy.

The occurrence of roads can cause substantial edge effects on forested stands, sometimes more than the harvest areas they access (Reed, et al. 1996; Bate and Wisdom, in prep.). Roads that are open to the public expose many important wildlife habitat features in old growth and other forested stands to loss through firewood gathering and increased fire risk.

Effects of disturbance also vary at the landscape level. Conversion from one stand condition to another can be detrimental to some old growth associated species if amounts of their preferred habitat are at or near threshold levels or dominated by linear patch shapes and limited interconnectedness (Keller and Anderson 1992). Reducing the block sizes of many later-seral/structural stage patches can further fragment existing and future old growth habitat (Richards et al. 2002). Depending on landscape position and extent, harvest or fire can remove forested cover that provides habitat linkages that appear to be "key components in metapopulation functioning" for numerous species (Lidicker and Koenig 1996, Witmer et al. 1998). Harvest or underburning of some late and mid seral/structural stage stands could accelerate the eventual creation of old growth in some areas (Camp, et al. 1996). The benefit of this approach depends on the degree of risk from natural disturbances if left untreated.

Effects on old growth habitat and old growth associated

species relate directly to … "Landscape dynamics—Connectivity"; and … "Landscape dynamics—Seral/structural stage patch size and shapes." (Pages 3-196 to 3-197.)

Harrison and Voller, 1998 state, "connectivity should be maintained at the landscape level." They adopt a definition of landscape connectivity as "the degree to which the landscape facilitates or impedes movement among resource patches." Also:

> Connectivity objectives should be set for each landscape unit. …Connectivity objectives need to account for all habitat disturbances within the landscape unit. The objectives must consider the duration and extent to which different disturbances will alienate habitats. … In all cases, the objectives must acknowledge that the mechanisms used to maintain connectivity will be required for decades or centuries.

(Id., internal citations omitted.) Harrison and Voller, 1998 further discuss these mechanisms:

> Linkages are mechanisms by which the principles of connectivity can be achieved. Although the definitions of linkages vary, all imply that there are connections or movement among habitat patches. Corridor is another term commonly used to refer to a tool for maintaining connectivity. …the successful functioning of a corridor or linkage should be judged in terms of the connectivity among subpopulations and the maintenance of potential metapopulation processes. (Internal citations omitted.)

L. Harris discusses connectivity and effective interior habitat of old-growth patches:

> Three factors that determine the effective size of an old-growth habitat island are (1) actual size; (2) distance from

a similar old-growth island; and (3) degree of habitat difference of the intervening matrix. ...(I)n order to achieve the same effective island size a stand of old-growth habitat that is surrounded by clearcut and regeneration stands should be perhaps ten times as large as an old-growth habitat island surrounded by a buffer zone of mature timber.

L. Harris discusses habitat effectiveness of fragmented old growth:

(A) 200-acre (80 ha) circular old-growth stand would consist of nearly 75% buffer area and only 25% equilibrium area. ...A circular stand would need to be about 7,000 acres (2,850 ha) in order to reduce the 600-foot buffer strip to 10% of the total area. It is important to note, however, that the surrounding buffer stand does not have to be old growth, but only tall enough and dense enough to prevent wind and light from entering below the canopy of the old-growth stand.

L. Harris believes that "biotic diversity will be maintained on public forest lands only if conservation planning is integrated with development planning; and site-specific protection areas must be designed so they function as an integrated landscape system." Also:

Because of our lack of knowledge about intricate old-growth ecosystem relations (see Franklin et al. 1981), and the notion that oceanic island never achieve the same level of richness as continental shelf islands, a major commitment must be made to set aside representative old-growth ecosystems. This is further justified because of the lack of sufficient acreage in the 100- to 200-year age class to

serve as replacement islands in the immediate future. …(A) way to moderate both the demands for and the stresses placed upon the old-growth ecosystem, and to enhance each island's effective area is to surround each with a long-rotation management area.

Logging and other disturbance associated with the project and other cumulative impacts would affect goshawk nesting, post-fledging family habitat, alternative nesting, foraging, competitors, prey and potential habitat, including areas far from cutting units. Research in the Kaibab National Forest found that goshawk populations decreased dramatically after partial logging, even when large buffers around nests were provided (Crocker-Bedford, 1990).

Reynolds, et al., provide a basis for a northern goshawk conservation strategy that could be implemented if landscape habitat considerations were to be taken into account. It is essential to viability of goshawks that 20-50% of old growth within their nesting areas be maintained (Id.). (See also Suring et al. 1993.) Graham, et al. 1999, USDA Forest Service 2000b, Iverson et al. 1996, and Suring et al. 1993 are more examples of northern goshawk conservation strategies the DNRC might adopt, if emphasis was more appropriately placed on species conservation and insuring viability rather than resource extraction.

USDA Forest Service, 2000b recommends that forest opening greater than 50-60 acres be avoided in the vicinity of goshawks. At least five years of monitoring is necessary to allow for effective estimates of habitat quality (Id.). Research suggests that a localized distribution of 50% old growth should be maintained to allow for viability of goshawks (Suring et al. 1993).

The scientific information provided in Center for Biological Diversity, 2004 also includes vital information on goshawks.

A fine-filter analysis was not conducted on goshawks. This species is neither listed under the Endangered Species Act nor considered a sensitive species by DNRC. The effects to this species are expected to be covered by the coarse-filter analysis.

Goshawks are often associated with a thick overstory cover and areas with a large number of large trees. For example, Hayward and Escano (1989) recommend an overstory canopy between 75 and 80%. According to the BE/BA for the Keystone Quartz EIS in the Beaverhead-Deerlodge NF, "Goshawks prefer vegetation structure that permits them to approach prey unseen and to use their flight maneuverability to advantage (Widen, 1989, Beier and Drennan 1997)…"

The issue of fragmentation should have been more thoroughly considered with respect to goshawks. Other edge-adapted species may compete with the goshawk and displace the goshawk if adequate amounts of forest interior habitat is not provided. Crocker-Bedford (1990) recommends that a foraging area of >5000 acres of dense forest, in which no logging is permitted, be designated for goshawks, with additional areas of 2500-5000 acres of more marginal habitat designated beyond this 5,000 acre foraging area.

The DEIS failed to disclose and analyze the uncertain and precarious population status of the fisher, as described in Witmer, et al., 1998:

> **The status of the fisher in the Western United States is poorly known but generally perceived as precarious and declining. This is a serious issue alone, but it also is a component of the larger problem of the decline of biological diversity. Recovery of species of concern must necessarily focus on the population level, because this is the scale at which genetic variation occurs and because population [sic] are the constituent elements of communities and ecosystems. Systematic habitat alteration and overexploitation have reduced the historical distribution of fish-**

DNRC recognizes the status of the fisher; thus, DNRC listed this species as sensitive *(DEIS, APPENDIX F - WILDLIFE ANALYSIS, pages F-25* and *F-26)*. As such, a fine-filter analysis was conducted *(DEIS, APPENDIX F - WILDLIFE ANALYSIS, pages F-26* through *F-28)*.

ers in suitable habitat in the interior Columbia basin to isolated and fragmented populations. Current populations may be extremely vulnerable to local and regional extirpation because of their lack of connectivity and their small numbers (Id. at 14, internal citations omitted).

The proposed project would adversely impact fisher habitat. Habitat elements for natal and maternal dens are found in large diameter logs or snags. These would be reduced in stands intensively managed for timber. "Though the post-treatment stand condition would not be 'clear cuts', they would be fairly open and Jones (1991) did not expect to find substantial fisher hunting use of plantations by fishers until canopy approached 80% and 10-15 feet respectively (depending on snow depths)" (Flathead NF's Spotted Beetle EA, p. 3-62). The extensive logging, snag removal and other activities associated with the project would negatively affect fisher habitat. Movement, denning, resting areas, genetic diversity, and other aspects of fisher life cycles and fisher survival could be impacted by the project; the FS does not fully consider these elements of the project or adequately mitigate their impacts. A finding of no significant impact is not warranted.

Jones (undated) and Johnsen, 1996) provides examples of beginning developments of conservation strategies for the fisher.

Regarding another logging-sensitive species, the black-backed woodpecker, Cherry (1997) states:

> The black-backed woodpecker appears to fill a niche that describes everything that foresters and fire fighters have attempted to eradicate. For about the last 50 years, disease

The fine-filter analysis discusses the potential effects to fishers and rationale for disclosure of minor negative effects under both alternatives *(DEIS, APPENDIX F - WILDLIFE ANALYSIS, pages F-26* through *F-28)*.

and fire have been considered enemies of the 'healthy' forest and have been combated relatively successfully. We have recently (within the last 0 to 15 years) realized that disease and fire have their place on the landscape, but the landscape is badly out of balance with the fire suppression and insect and disease reduction activities (i.e. salvage logging) of the last 50 years. Therefore, the black-backed woodpecker is likely not to be abundant as it once was, and continued fire suppression and insect eradication is likely to cause further decline.

Past actions were, unfortunately consistent with this policy, and now the proposed project would further that failed policy. Nowhere does the DEIS disclose the impacts on woodpeckers and other species that rely on agents causing tree mortality.

The Region 1 black-backed woodpecker assessment (Hillis et al., 2003) notes that the black-backed woodpecker depends upon the very forest conditions that the DNRC so often vilifies:

Black-backed woodpeckers occupy forested habitats that contain high densities of recently dead or dying trees that have been colonized by bark beetles and woodborer beetles (Buprestidae, Cerambycidae, and Scolytidae). These beetles and their larvae are most abundant within burned forests. In unburned forests, bark beetle and woodborer infested trees are found primarily in areas that have undergone natural disturbances, such as wind-throw, and within structurally diverse old-growth forests. (Internal citations omitted.)

...Black-backed woodpeckers also occur in unburned landscapes Bull et al.1986, Goggans et al. 1987, Bate

The coarse-filter analysis pertaining to deadwood discusses the effects to insectivorous species *(DEIS, APPENDIX F - WILDLIFE ANALYSIS, pages F-3, F-5, F-7, and F-8)*.

1995, Hoffman 1997, Weinhagen 1998, Steeger and Dulisse in press, Taylor unpublished data). Taylor's observations of black-backed woodpeckers in unburned forests in northern Idaho suggest that they may occur at substantially lower densities in unburned forests, but no rigorous comparisons between black-backed woodpecker densities in burned and unburned forests have been done. Hutto (1995) hypothesized that black-backed woodpeckers reproduce at *source* reproductive levels in burns, but may drop to *sink* reproductive levels in the intervening periods between large burns.

Dolan (1998a,b) states in regards to impacts on the black-backed woodpecker due to fire suppression and post-fire logging states:

> **It seems that we have a huge cumulative effects problem here, and that each salvage sale removes habitat that is already very limited. We are having trouble avoiding a "trend to federal listing" call for the BBWO in salvaging burns, unless comparable acres of fire-killed dead are being created through prescribed burns.**

The comments by other biologists attached to Dolan, 1998a,b reveal that no one has yet designed a consistent, workable, scientifically defensible strategy to ensure viable populations of the black-backed woodpeckers. The fire suppression and "salvage" logging policies of our land managing agencies are the biggest threat to black-backed woodpecker population viability, unfortunately in failing to create a conservation strategy the cumulative impacts of ongoing fire suppression policy will remain unexamined.

Lofroth (1997) in a study in British Columbia, found that wolverines use habitats as diverse as tundra and old-growth forest. Wolverines are also known to use mid- to low-elevation Douglas-fir forests in the winter (USDA Forest Service, 1993).

Ruggerio, et al. (1998) and Bull and Blumton, 1999, indicate that vertical and horizontal diversity provided by snags and large down woody debris are important habitat characteristics for the pine marten, another old-growth wildlife species. The logging proposed for this project would reduce the availability of prey species for the marten.

Old growth allows martens to avoid predators, provides resting and denning places in coarse woody debris and large diameter trees, and allows for access under the snow surface. USDA Forest Service (1990) is summary of old-growth habitat needs of martens reviewed research suggesting that martens prefer forest stands with greater than 40% tree canopy closure and rarely venture more than 150 feet from forest cover, particularly in winter. It also cites research suggesting that at least 50% of female marten home range should be maintained in mature or old growth forest. Also, consideration of habitat connectivity is essential to ensuring marten viability: "To ensure that a viable population of marten is maintained across its range, suitable habitat for individual martens should be distributed geographically in a manner that allows interchange of individuals between habitat patches (Ibid.).

The flammulated, boreal owl and the great gray owl are species of concern that are sensitive to logging and other management activities. See, for example, Hayward and Verner, 1994.

The paltry number of snags and green tree replacements to be retained in some logging units and the failure to specify snags of adequate size contrasts with scientifically determined habitat needs acknowledged elsewhere by the FS. The DEIS doesn't even refer to recently developed Regional snag guidelines (USDA Forest Service, 2000d. Harris (1999—cited in the DEIS) and ICBEMP DSEIS Appendix 12 present scientific information that contrasts with the DEIS on this topic.

Typically, data to assess these densities are not collected until timber sale preparation. In this project, snag sampling occurred and was reported; however, the quarter-acre plot means, not snag densities, were erroneously reported. This error was corrected in the *FEIS*.

DNRC committed to retain large snags (21 inches dbh or

The high density of snags and defective trees within old growth (Green et al. 1992) would be substantially eliminated with the planned logging. And the DEIS does not disclose how many old logging units in the project area are deficient in snags, another vital and necessary component of old-growth habitat.

Bull, et al., 1997 state:

> This document presents new information on the retention and selection of trees and logs most valuable to wildlife.
>
> …Current direction for providing wildlife habitat on public forest lands does not reflect this new information. Since the publication of Thomas and others (1979), new research suggests that to fully meet the needs of wildlife, additional snags and habitat are required for foraging, denning, nesting, and roosting. Although we do not suggest specific numbers or snags to retain by forest type, tow recent studies indicate that viable woodpecker populations occurred in areas with about four snags per acre.
>
> We suggest that the next step in snag management should involve creating a model that incorporates the new information on woodpecker foraging substrates (live trees, snags, and logs), home range sizes, number and characteristics of roost trees, multiple occupancy of snags, and needs for other habitat structures. Once this information is incorporated, the model may suggest changes to guidelines that specify numbers of snags and other habitat features by forest type and geographic area. Additional information on fall rates of snags, foraging needs of black-backed and three-toed woodpeckers, relation of the density of woodpeckers to that of secondary cavity nesters, and relation of snag density to woodpecker density would greatly improve the model.

The DEIS does not adequately consider that snags may be cut down for safety reasons during logging operations (due to OSHA regulations). The DEIS fails to disclose the amount of snag loss expected because of safety concerns and also skyline corridors and other methods of log removal—the loss could be more significant that disclosed, because the DEIS doesn't provide any idea the degree of snag loss due to these concerns. The paucity of snag habitat in previously logged areas is no doubt at least partially attributed to concerns over logger safety.

greater) in development of this timber sale project in accordance with ARM 36.11.411. DNRC will ensure that the minimum standard is met postharvest. This rule, however, does not require the retention of smaller snags. For this project, some additional snags of varying size classes are planned for retention to mitigate effects to species that use snags. The effects of snag loss were discussed in the *DEIS, (APPENDIX F - WILDLIFE ANALYSIS, page F-9).*

The DEIS acknowledges the potential loss of retention snags due to operational/safety constraints *(DEIS, APPENDIX F - WILDLIFE ANALYSIS, page F-9; APPENDIX B - VEGETATION ANALYSIS, page B-11; and CHAPTER II - ALTERNATIVES, page II-12).* The *DEIS (APPENDIX A - STIPULATIONS AND SPECIFICATIONS, page A-3, under SNAG RETENTION)* displays the minimum number and size of snags and snag recruitments that should be retained in the proposed harvest areas.

The degree to which pileated woodpeckers prefer larger trees/snags for nesting is not recognized by the DEIS. Also, USDA Forest Service, 1990 states, "To provide suitable pileated woodpecker habitat, strips should be at least 300 feet in width..." The DEIS also ignores many structural habitat components necessary for the pileated woodpecker. USDA Forest Service, 1990 indicates that measurements of the following variables are necessary to determine quality and suitability of pileated woodpecker habitat:

- Canopy cover in nesting stands
- Canopy cover in feeding stands
- Number of potential nesting trees >20" dbh per acre
- Number of potential nesting trees >30" dbh per acre
- Average DBH of potential nest trees larger than 20" dbh
- Number of potential feeding sites per acre
- Average diameter of potential feeding sites

The description of habitat features used by pileated woodpeckers acknowledges the need for large trees and snags (DEIS, APPENDIX F - WILDLIFE ANALYSIS, page F-28).

The preferred very large diameter of nesting trees for the pileated woodpecker recognized by USDA Forest Service (1990) (and ignored by the snag retention strategy in the DEIS) is notable. McClelland and McClelland, 1999 found similar results in their study in northwest Montana, with the average nest tree being 73 cm. (almost 29") dbh. With the value of trees—live, dead, and down—being so disproportionately high the larger the size they attain, one might think that limiting the size of trees for removal would be important. The DEIS doesn't recognize such a basic concept. The DEIS effectively provides no commitments for leaving specific numbers and sizes of largest trees favored by so many wildlife species.

ARM 36.11.411 requires that 1 large snag and 1 large snag-recruitment tree per acre be retained following harvesting (DEIS, APPENDIX F - WILDLIFE ANALYSIS, page F-9). In the proposed alternatives, large snags and large snag-recruitment trees would be targeted for retention (DEIS, APPENDIX A - STIPULATIONS AND SPECIFICATIONS, page A-3).

It is also unclear as to how it's possible for the DEIS to estimate, without any field survey validation, the amount of existing snags and coarse woody debris.

Snag densities were determined through plot data on the stands that were field surveyed for old-growth verification. *SLI* data displays snag sizes and the number of snags per acre that are based on field reconnaissance and point sampling within the stand. Estimates of coarse woody debris are made by transect samples conducted within stands.

"Well distributed habitat is the amount and location of required habitat which assure that individuals from demes, distributed throughout the population's existing range, can interact. Habitat should be located so that genetic exchange among all demes is possible." (Mealey, 1983.) That document also provides guidance as to how habitat for the pileated woodpecker must be

distributed for populations to persist.

The IPNF's Forest Plan provides an example of better management directives for the pileated woodpecker than does the DNRC. IPNF's Forest Plan Wildlife Standard #10f requires "One or more old-growth stands per old-growth unit should be 300 acres or larger. Preference should be given to a contiguous stand; however, the stand may be subdivided into stands of 100 acres or larger if stands are within one mile. The remaining old-growth management stands should be at least 25 acres in size. Preferred size is 80 plus acres." IPNF Forest Plan at II-29. This and other IPNF old growth Standards are based upon what the IPNF recognizes are pileated woodpecker habitat needs:

To retain a viable population of pileated woodpeckers on the IPNF … our recommendations are:

1. Retain 10 percent old-growth throughout the Forests.
2. Distribute the old-growth so that old-growth compartments with 5 percent old-growth retain at least 5 percent old-growth. All old-growth stands 25 acres should be retained in old-growth compartments containing less than 5 percent old-growth.
3. In each 10,000 acre unit at least 300 acres should be managed specifically for pileated woodpeckers. To maximize benefits to other species as well as pileateds the 300 acres should be either contiguous or divided into subunits no smaller than 100 acres. The subunits should be within approximately two square miles.
4. The areas managed for pileated woodpeckers should be at least 200 yards wide.
5. Areas selected for old-growth management for pileated woodpeckers should also be close to water. Old-growth larch stands are highly recommended for pileated woodpecker management.

(IPNF Forest Plan EIS Appendix 27 at p. II-40.)

Since the DEIS provides inadequate analysis regarding the size and quality of habitat blocks needed by the pileated woodpecker, the analysis completely fails to disclose the quantitative or qualitative significance of cumulative effects due to past logging in the area.

B.R. McClelland has extensively studied the pileated woodpecker habitat needs. To quote a March 12, 1985 letter from B.R. McClelland to Flathead NF Supervisor Edgar B. Brannon:

The *DEIS (APPENDIX F - WILDLIFE ANALYSIS, page F-28)* describes how potential pileated woodpecker habitat was identified by searching the *SLI* database. It has already been described that this database considers past harvests. Rationale is also given as to why the project area would be considered the analysis area for cumulative effects.

Past harvests contributed to the existing condition. Each alternative was compared to this condition to

Co-workers and I now have a record of more than 90 active pileated woodpecker nests and roosts, …the mean dbh of these trees is 30 inches… A few nests are in trees 20 inches or even smaller, but the minimum cannot be considered suitable in the long-term. Our only 2 samples of pileateds nesting in trees <20 inches dbh ended in nest failure… At the current time there are many 20 inch or smaller larch, yet few pileateds selected them. Pileateds select old/old growth because old/old growth provides habitat with a higher probability of successful nesting and long term survival. They are "programmed" to make that choice after centuries of evolving with old growth.

We request that you apply research from McClelland (1977), which states:

(The Pileated Woodpecker) is the most sensitive hole nester since it requires old growth larch, ponderosa pine, or black cottonwood for successful nesting. The Pileated can be considered as key to the welfare of most hole-nesting species. If suitable habitat for its perpetuation is provided, most other hole-nesting species will be accommodated.

Pileated Woodpeckers use nest trees with the largest dbh: mean 32.5 inches;

Pileated Woodpeckers use the tallest nest trees: mean 94.6 feet;

The nest tree search image of the Pileated Woodpecker is a western larch, ponderosa pine, or black cottonwood snag with a broken top (status 2), greater than 24 inches dbh, taller than 60 feet (usually much taller), with bark missing on at least the upper half of the snag, heartwood substan-

assess effects. Therefore, past harvests were considered in the analysis, but not itemized. Additional harvests within the project area are not expected in the foreseeable future. Therefore, cumulative effects are expected to be similar to the direct and indirect effects.

tially affected by Fomes laracis or Fomes pini decay, and within an old-growth stand with a basal area of at least 100 sq feet/acre, composed of large dbh classes.

A cluster analysis based on a nine-dimensional ordination of nest tree traits and habitat traits revealed close association between Yellow-bellied Sapsuckers, Mountain Chickadees, and Red-breasted Nuthatches. These three species plus the Pileated Woodpecker and Hairy Woodpecker are relatively grouped by coincident occurrence in old growth. Tree Swallows, Black-capped Chickadees, and Common Flickers are separated from the above five species by their preference for more open areas and their frequent use of small dbh nest trees.

Limiting Factors

In old-growth, western larch-Douglas-fir forests, snags or culls suitable for nest sites do not seem to be generally limiting. … Probably no single factor limits hole nesters, but rather a complex interplay of factors. Either nest trees or food supply may be limiting in logged areas.

We also urge you to consider the "Management Implications" McClelland, 1977 makes.

McClelland, et al., 1979 state:

(Most) species found optimum nesting habitat in stands with a major component of old growth, particularly larch. Mean basal area for pileated woodpecker nest sites was 150 square feet per acre. (McClelland. B.R. and others, 1979)

In western larch-Douglas-fir forests, nest sites of pileated

woodpeckers appear to be limited to areas with an old-growth component. The feeding territory used by one pair on a year-round basis is large, between 500 and 1,000 acres.

Many large snags are being cut for firewood. Forest managers should limit firewood cutting to snags less than 15 inches in d.b.h. and discourage use of larch, ponderosa pine, and black cottonwood. Closure of logging roads may be necessary to save high-value snags. Logging slash can be made available for wood gatherers.

The DEIS doesn't genuinely contain a cumulative effects analysis for wildlife species. Effects, either adverse or beneficial, of past management activities are not disclosed. There is no discussion of the connection between the major individual management actions carried out in the past, and the environmental harms or benefits.

Past harvests contributed to the existing condition. Each alternative was compared to this condition to assess effects. Therefore, past harvests were considered in the analysis, but not itemized.

The fact that Swift Creek is a WQLS means that most of the DEIS's standard mitigation and modeling assumptions cannot be relied upon for maintaining and improving water quality and fish populations.

Data on effectiveness of BMPs statewide may be found in the *Forestry BMP Audit Report (DNRC, 1990, 1992, 1994, 1996, 1998, 2000, 2002, 2004)*. DNRC also conducts evaluations of mitigation measures through timber sale administration inspection reports and internal BMP audits annually. Results of the internal BMP audits can be found in monitoring reports prepared for the Montana Board of Land Commissioners.

DNRC has conducted a qualitative analysis for potential effects to fish populations throughout the project area even though DNRC is not specifically responsible for maintaining or improving fish populations. DFWP is responsible for the management of fish populations, and the qualitative analysis of this variable within the DEIS was conducted in an effort to provide the maximum level of practical information to the project decisionmaker.

The DEIS fails to use the best science concerning road densities and bull trout. The US Fish and Wildlife Service's Bull Trout Interim Conservation Guidance states:

> **Bull trout are less likely to use streams in highly roaded areas for spawning and rearing, and where found in highly roaded areas are less likely to be at strong population levels. Bull trout strongholds in the Interior Columbia River Basin showed a very strong (P=0.0001) negative correlation with road densities. The average road density in bull trout strongholds was 0.45 mi/mi^2, which is considerably less than the standard 2-3 mi/mi2 reported as adequate for populations of anadromous salmonids. Bull trout populations classified as "depressed" had an average watershed road density of 1.4 mi/ mi^2 and bull trout typically were absent in an average road density of 1.7 mi/ mi^2. Although some variability in these patterns was apparent the association was strong, suggesting that bull trout are exceptionally sensitive to the direct, indirect, or cumulative effects of roads. (From information contained in the ICBEMP aquatic assessment by Quigley et al. 1997, emphasis added.)**

The fisheries analysis of the *DEIS* does not analyze for road densities relative to bull trout for 4 reasons:

1) The limited amount of scientific literature related to road densities and bull trout and other native salmonids pertains to broad generalizations of large geographic areas, such as the bulk of the Columbia River basin *(Quigley et al 1997)*.

2) Mean qualitative or quantitative values of road density (as they relate to bull trout) derived from large demographic areas do not take into account the road maintenance guidelines and standards of different landowners throughout watersheds.

3) *Although reductions in road densities can potentially lead to reduced sedimentation, there are no known regionally established indices for road densities in northwestern Montana that are correlated to bull trout and other native salmonid densities.*

4) *Due to the lack of regional or agency-specific baseline data of road density related to bull trout success, a minimal narrative or other qualitative effects analysis of the issue could not accurately determine if decreased or increased road densities within the project area would adversely affect bull trout (or other native salmonids).*

The detailed fisheries analysis within the *DEIS (APPENDIX E - FISHERIES ANALYSIS)* describes the direct, indirect, and cumulative effects of road mitigations and potential sedimentation as a result of each alternative; this information is a more effective methodology for describing the effects of roads within the project area on bull trout than road density. *(*Quigley, T.M. and S.J. Arbelbide, tech eds., 1997. An assessment of ecosystem components in the interior Columbia basin and portions of the Klamath and Great Basins: volume 3. Gen Tech Rep. PNW-GTR-405. Portland, OR: U.S.D.A., Forest Service, Pacific Northwest Research Station, 4 vol.)*

The *Quigley et al 1997* study is an excellent assessment that evaluates trends in general road densities (which

Road densities exceed the level needed to support healthy populations of bull trout. One bull trout conservation objectives is to: "Manage or reduce negative effects of roads to habitat in bull trout watersheds by repairing and relocating roads, and by decreasing current road densities" (emphasis added). The proposed project does not adequately meet this objective.

are cited in the study as a surrogate for human disturbance) relative to bull trout success throughout a very large geographic area. However, if DNRC had determined that road density relative to bull trout success was an appropriate measure of analysis for this *DEIS* project area, *Quigley et al 1997* would not be an accurate set of criteria to determine potential effects for several reasons. The *Quigley et al 1997* study area encompasses large areas of underlying granitic geology (batholiths), which tend to be more susceptible to erosion from road construction and maintenance than the glacial-dominated belt-rocks predominantly found throughout this project area *(J. Collins, 2004 [personal conversation] December, Missoula, MT:DNRC)*. An increased risk of erosion per road mile, in this case would generally translate to an increased risk to bull trout success. The study incorporates large areas of federal lands, which may take into account road systems throughout steep, high elevation, and potentially more erosive terrain than those found in the lower elevation, and potentially less erosive, land that is typically found throughout the project area. The study also does not distinguish between different road types, such as open/closed, reclaimed, brushed in, hydrologically stabilized, etc. Different road types are typically susceptible to different levels of erosion, which could lead to compounding error when using the values found in *Quigley et al 1997* as a baseline for any analysis of potential road impacts throughout the project area on State trust lands.

As described above, road densities are not an appropriate measure or surrogate for analyzing potential effects to bull trout populations throughout this project area. The objective stated by the commenter is presumably taken from the Bull Trout Interim Conservation Guidance *(USFWS 1998)*, which is not intended to provide site-specific land-management prescriptions. Although DNRC may take steps to reduce sedimentation from existing roads by implementing BMPs, removing several deteriorating log and earthen stream crossings, and relocating segments of road away from stream channels, DNRC is under no obligation to adhere

The DEIS's watershed analysis relies, to a great degree, upon the ECA (Equivalent Clearcut Acres) modeling procedure. Please consider the fact that research (King, 1989) is critical about the accuracy of a peakflow model, similar to the ECA method, in estimating increases in peakflows from logging and roads in nearby northern Idaho. King (1989) examined the veracity of a model for changes in peakflow as a function of ECA. He found that the ECA model consistently underestimated measured increases in flow caused by roads and logging.

to or meet the objectives outlined in the *Bull Trout Interim Conservation Guidance (USFWS 1998).*

In his summary, *King (1989)* states, "The ECA procedure currently estimates streamflow responses in third- to fifth-order watersheds and does not directly consider hydrologic responses in smaller headwater streams." In the introduction of the *King (1989)* study, the author states, "This analysis will be used to describe the peakflow responses for small south-facing watersheds. These results cannot be used to improve any relationship in the ECA procedure because the procedure is usually applied to much larger watersheds." *Under the Peak Streamflows* section, *King (1989)* states, "The modifications in maximum monthly streamflow from the Horse Creek watersheds with harvest units and roads cannot be compared with predicted responses in the ECA procedure because of the small size of the Horse Creek areas. The ECA procedure was developed for much larger watersheds and does not consider modifications in streamflow in headwater basins." These statements show that the author is continually reminding the reader that the model being critiqued is not designed to show results in small first-order watersheds. It is not surprising that ECA model results underestimated water-yield increases to first- and second-order watersheds ranging in size from 58 acres to 364 acres. The ECA model is designed for third- to fifth-order watersheds ranging in size from several thousand acres to 50,000 acres. At small scales of analysis, water-yield increases would be more pronounced. Use of the ECA model on areas over 50,000 acres would also yield inaccurate results with impacts being "washed out" by an area larger than the model is designed to approximate. Choosing the appropriate scale of analysis and finding the proper tool to accomplish that analysis is an important step in a watershed assessment and comparison of expected watershed impacts. The primary purpose of any water-yield model is to simplify extremely complex natural systems, not to provide precise or exact quantities of expected results.

The ECA model outputs are also inadequate to disclose the effects of the alternatives and cumulative effects on peak-flows and resultant impacts on aquatic resources, because the model estimates changes in average monthly peakflow caused by logging and roads. Does the DEIS's analysis only discusses cumulative and alternative effects on these average monthly peakflows? King (1989) clearly noted that estimates of average monthly peakflows triggered by logging and roads are not adequate for estimating likely changes in channel conditions and sediment transport caused by log-ging and roads. He noted:

...the largest 7 or 8 days of streamflow account for the majority of the bedload movement...Average monthly streamflows are usually not a good index of bedload transport, and 'changes in average an-nual monthly peakflows have no meaningful effect on sediment transport' (Megahan, 1979) and are thus poor indicators of changes in channel-forming flows.

King (1989) also stated:

> **Thus, it is the relatively few high flow days that have the potential for shaping the channel. Increases in short duration high flows following harvesting and road building are more important in terms of potential channel erosion and bedload transport than increases in longer duration high flows such as the maximum mean monthly streamflows... (emphasis added).**
>
> **Therefore, increases in short-duration highflows are more important than longer duration highflows in shaping the channel, and any procedure to estimate streamflow responses and set limits on harvesting should focus on these shorter duration highflows.**

The ECA model relies on climatic conditions averaged over long periods. Therefore, the model is less reflective of individual drought or flood years. The ECA model is intended for use to develop a baseline condition (fully forested), describe the changes caused by past management (existing conditions), and compare each of these to anticipated changes from the alternative proposals. Peak-flow events are included in the climatic data used to establish the baseline, but are not directly and separately considered since they relate primarily to meteorological phenomena that are outside the scope of this analysis.

King (1989) clearly indicates that the estimates of effects on average monthly peakflows is inadequate for determining the effects of the alternatives and cumulative effects on peakflows and resultant impacts on channel erosion, bed-load transport, sedimentation, bank erosion, fish habitat, fish survival, and downstream flooding impacts. Certainly, the lack of models' proven reliability and validity indicate the need for an alternative that would create no more of the WQLSs' probable sources and probable causes, which include sediment induced by logging, road building, and simply the present road conditions.

The DEIS's analysis of changes in monthly peakflow is not a surrogate for estimates of daily and instantaneous peakflows triggered by the alternatives and in combination with the cumulative effects of the existing road network and past logging. These peakflow attributes, which are ignored in the EIS, are most important for determining the likely effects on channels and sediment transport triggered by logging and roads (King, 1989). Average peakflows are not of greatest concern. Sediment transport and channel change are greatly affected during extreme events.

As stated in the *DEIS (APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS, pages C-5* through *C-8)* each of the action alternatives would reduce the sediment load to the West Fork of Swift Creek and Swift Creek. Please see the 2 prior responses in addressing the validity of the ECA model.

Stream-channel stability is one of the primary factors in determining the resistance of a stream channel to resist degradation during high-flow events. As discussed in the *DEIS (APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS, pages C-1* through *C-4)*, channel stability was assessed in the project area, and allowable water-yield increases were set based on these assessments, watershed sensitivity, and acceptable risk. In his *Summary and Recommendations* section, *King (1989)* stated, "...the results would indicate that harvesting in low-order watersheds that have channel conditions that may be sensitive to increases in short duration peakflows should proceed on a conservative basis. In many instances, the channels may be stable enough to withstand fairly large increases in short duration peakflows without any channel alteration." In addition, *MacDonald and Hoffman (1995)* state, "...there was no apparent correlation between the magnitude of peak flows and the amount of forest harvest," and further, "It appears that local climatic conditions are the dominant control of the magnitude of peak flows."

Within portions of this region, rain-on-snow (ROS) events during the fall, winter and spring months have been found to be a dominant mechanism causing peak flows (MacDonald and Hoffman, 1995). The DEIS fails to disclose that the modeling the DEIS relies upon does not estimate the effects of ROS events and other instantaneous peak flow events, which the DEIS itself discloses may result in significant damage to project area watersheds.

While it is agreed that rain-on-snow events have the potential to alter stream channels, the occurrence duration and intensity of these events cannot be predicted. Meteorological phenomena, such as droughts, high precipitation, and warm spells (winter or summer), are difficult to model more than several days in advance. It would be nearly impossible to model these events for any given year with statistical accuracy. It is, therefore, infeasible to include such phenomena in a water-yield model. The results of the anticipated average annual water-yield changes as a result of the proposed project are reported in the *DEIS (APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS, pages C-9* through *C-11)*.

Another major problem with the water models, such as the ECA, is that they fail to take into account the extreme peak flow increases due to the high density of roads in the project area. Kootenai National Forest Hydrologist Steve Johnson, states, "Impacts from roads basically fall into three areas: introduced sediment into streams; snowmelt re-direction and concentration; and surface flow production." (Johnson, 1995)

Johnson (1995) discusses how "snowmelt re-direction and concentration and surface flow production" increase peak flow amounts multiplicatively by the presence of roads in a drainage. The DEIS fails to acknowledge the degree to which roads increase peak flows above the amounts models estimate.

The water-yield analysis *(DEIS, APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS, pages C-9* through *C-11)* has incorporated the expected water-yield increases from all past activities, including the existing road system. The ECA spreadsheet used in this analysis doubles the percent of increase on roads that is assigned to clearcut equivalents. These values are incorporated into the numbers reported in the *DEIS, (APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS)*.

Johnson (1995) adds, "For the roads we no longer actively use, our dwindling road maintenance budget will make it difficult to maintain the culvert crossings. When these fail during storm and runoff events, tremendous amounts of

Through ARM 36.11.421, DNRC will manage roads to minimize maintenance, maintain roads commensurate with expected road use and appropriate resource protection, and inspect road conditions on both restricted and open roads every 5 years. Maintenance needs are prioritized

sediment can be delivered directly to the channel and from there down to lower streams with significant beneficial uses such as sensitive fish habitat." The DEIS fails to disclose the significance of any foreseeable lack of maintenance, and the direct, indirect and cumulative effects poorly maintained roads have on water quality.

Johnson (1995) also pointed out that an old road design that utilized ditches on the inside of the road greatly increases drainage efficiency, causing peak flows to go far beyond any modeled predictions. The very existence of the current road network is causing major water quality impacts.

It is totally misleading to state that BMPs will assure water quality will be maintained, when present conditions are already in violation of the standards. BMPs were either ineffective or must have been violated—which is it?

The failure of BMPs is obviously implicated in this watershed. Beschta et al. (2004) state:
It is perhaps widely accepted that "best management practices" (BMPs) can reduce damage to aquatic environments from roads. Time trends in aquatic habitat indicators indicate, however, that BMPs fail to protect salmonid habitats from cumulative degradation by roads and logging (Espinosa et al. 1997.) Ziemer and Lisle (1993) note a lack of reliable data showing that BMPs are cumulatively effective in protecting aquatic resources from damage.

and funding may come from the FI program, grants, or be incorporated into planned projects such as timber sales or permits.

The effects to water quality are displayed in the *DEIS (APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS, pages C-5* through *C-8)*.

The water-yield analysis *(DEIS, APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS, pages C-9* through *C-11)* has incorporated the expected water-yield increases from all past activities, including the existing road system. The ECA spreadsheet used in this analysis doubles the percent of increase on roads that is assigned to clearcut equivalents. These values are incorporated into the numbers reported in the *DEIS (APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS).*

The *2002 Forestry BMP Audit Report* found a 97 percent effectiveness rate for all practices in State-wide audits and a 99 percent effectiveness rate for practices on DNRC timber sales. In addition to standard BMPs, the *DEIS (APPENDIX C – WATERSHED AND HYDROLOGY ANALYSIS, pages C-5 through C-8)* discloses the anticipated impacts of BMPs and other improvements and repairs to existing sediment sources in the proposed project area. All of the existing roads in the proposed project area were constructed prior to the development of BMPs, and most have not been used for timber management since the adoption of BMPs. Road segments that have been used since the adoption of BMPs have had applicable measures applied in order to reduce sediment delivery. For these reasons, the BMPs have not failed or been violated, they were neither applied nor required at the time of use. If BMPs at individual sites lead to reductions in sediment delivery, it stands to reason that cumulatively BMPs are protecting and, in some cases, improving water quality.

The DEIS failed to provide a genuine watershed-wide cumulative effects analysis for Swift Creek.

A definition of the analysis area is found in the *DEIS (APPENDIX C-WATERSHED AND HYDROLOGY ANALYSIS, page C-2)*; the cumulative-effects analysis is found on pages *C-7* through *C-11*.

The DEIS fails to disclose the sediment yield due to simply increase use of the roads due to logging and administrative traffic. From an investigation of the Bitterroot Burned Area Recovery Project, hydrologist Rhodes (2002) notes, "On all haul roads evaluated, haul traffic has created a copious amounts of mobile, non-cohesive sediment on the road surfaces that will elevate erosion and consequent sedimentation, during rain and snowmelt events."

In the sediment-yield analysis, loss of vegetation from road surfaces was accounted for on all roads proposed for log hauling according to procedures detailed in *the DEIS (APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS, page C-1)*.

Through *ARM 36.11.421*, DNRC will manage roads to minimize maintenance, maintain roads commensurate with expected road use and appropriate resource protection, and inspect road conditions on both restricted and open roads every 5 years. Maintenance needs are prioritized and funding may come from the FI program, grants, or incorporated into planned projects such as timber sale or permits.

The DEIS does not provide any analysis of the synergistic cumulative effects of openings created by roads and logging. This includes their spatial relations, their juxtaposition, considering such factors as slope, road drainage system condition, aspect, elevation, etc.

The water-yield analysis conducted includes both logging units and roads constructed. The water-yield analysis procedures are described in the DEIS, APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS, pages C-1 and C-2. The ECA model includes the precipitation zone when calculating existing conditions and estimating the effects of proposed management on both existing and proposed harvesting and roads. The condition of the road drainage system is considered in the DEIS, CHAPTER II, pages II-18 and II-19; CHAPTER III, pages III-12 through III-15; and APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS, pages C-3 through C-8.

There is inadequate disclosure of the present and expected levels of fine and bedload sediment transport and deposit for analysis area streams. The present conditions concerning the two are not distinguished from each other in terms of cumulative effects.

The *DEIS (APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS, pages C-3* through *C-8)* disclose the current and expected levels of fine sediment delivered to streams. As reported, fine-sediment levels are expected to decrease as a result of the proposed action alternatives. Likewise, with a reduction in sediment delivery to streams, bedload sediment would also be reduced from current levels.

The DEIS does not utilize up-to-date fish population surveys and surveys of fish habitat conditions. The DEIS cites no population or inventory or monitoring data for the native fish species at issue in the project area or for Swift Creek as a whole. Distribution, status and population trends have not been determined.

The fisheries analysis portion has compiled and described all known up-to-date fish population surveys for the project area. The DEIS (APPENDIX E - FISHERIES ANALYSIS, TABLE D-1 - BULL TROUT POPULATION ESTIMATES IN WEST FORK SWIFT CREEK, 1995 THROUGH 2003) describes bull trout population estimates from DFWP in West Fork from 1995 through 2003. Up-to-date redd count data from DFWP, which is one indicator of general fish populations trends, has also been used for both bull trout and westslope cutthroat trout population assessments in the West Fork. Up-to-date quantitative R1/R4 data for describing fish habitat conditions in the West Fork is detailed in *DEIS (APPENDIX E - FISHERIES, TABLE D-3 - R1/R4 FISH HABITAT STANDARD INVENTORY RESULTS FROM THE WEST FORK SWIFT CREEK [KOOPAL 2001])*. Other recent assessments of fish habitat conditions are described in the habitat variables sections for the Existing Conditions of both Stryker and Johnson creeks.

Population, inventory, and monitoring data for bull trout and westslope cutthroat trout was not compiled and analyzed for the main stem of Swift Creek. In respect to fisheries, the main stem of Swift Creek is downstream and well outside of the project area, and this higher order reach was determined to have a large order of differential spatial magnitude compared to those fish-bearing streams within the project area. Therefore, the effects analysis for the fisheries portion of the DEIS is limited in scope to those fish-bearing streams within the project area where a reasonably accurate effects analysis could be conducted.

Within the fisheries-analysis portion of the *DEIS (APPENDIX E - FISHERIES ANALYSIS)* bull trout and westslope cutthroat trout distribution, status, and population trends have been identified in the *Existing Conditions* section for the West Fork and Stryker and Johnson creeks using current data that was logistically and financially available for the project area.

Why does the DNRC not survey for fry emergence as suggested by Rieman and McIntyre, 1993 (cited in the DEIS) since that is such an important factor for maintaining populations?

DNRC is responsible for the management of State trust lands, and DFWP is responsible for conducting various fish-population surveys, such as fry emergence surveys. That is the reason DNRC does not survey for fry emergence. DNRC has ongoing interagency agreements to logistically and financially support many of the various fish population surveys that DFWP conducts on trust lands, including those within the project area.

Has the DNRC validated its modeled sediment estimates vs. the amounts measured at monitoring stations?

The sediment-modeling procedure used in the DEIS is a model; values are not intended as absolute values, but rather as a comparison between the current situation and the proposed action alternatives. The methodology used was initially developed by the *Washington Forest Practice Board (1997)*, and is a quantifiable, repeatable process with values and coefficients based on field research and extrapolated to the project area. Water-quality monitoring sites would not be able to distinguish the levels of total suspended solids attributed to the road system from the natural background levels of total suspended solids in the project area watersheds.

The DEIS fails to disclose the risk of resulting chronic watershed impacts of continuing sub-standard roads. Even if all roads were to be brought up to BMP standards, maintenance will be needed in following years, with uncertain funding to achieve it.

Through *ARM 36.11.421*, DNRC will manage roads to minimize maintenance, maintain roads commensurate with expected road use and appropriate resource protection, and inspect road conditions on both restricted and open roads every 5 years. Maintenance needs are prioritized and funding may come from the FI program, grants, or be incorporated into planned projects such as timber sales or permits.

The DEIS does not disclose the degree to which commitments for watershed restoration, road maintenance, and road obliteration will be completed in a reasonable time frame, which means that project activities could simply cause additional damage to project area streams and the money for road work will run out even though watershed-damaging logging will go on.

The DEIS *(CHAPTER II, page II-2)*, indicates that BMP improvements on roads would be made prior to hauling logs over them. The timing of restoration activities, road maintenance, and road reclamation would be described in Contract Agreements with DNRC. Stipulations found in *APPENDIX A - STIPULATIONS AND SPECIFICATIONS* would be followed. The financing of those projects covered under the *TIMBER SALE AGREEMENT* are the responsibility of the Purchaser, and the administration of the timely implementation associated with the contract is DNRC's responsibility.

The DEIS acknowledges that skidding could negatively effect 12.4% to 14% of each cutting unit. (p. III-17). Yet there is no cumulative effects analysis of land base compacted and/or negatively impacted from past roading and logging nor an analysis of how these negative soil impacts affect productivity.

The DEIS does not disclose how past management has impacted soil productivity in the project area. There is nothing in the DEIS that itemizes the various kinds and levels of soil damage in the various disturbed sites from past logging activities in the watershed. While representing its management as "sustained yield" the DNRC really has no idea how its heavy-handed timber management has, or will, affect timber production in the second, third, and later rotations on school trust land. The DNRC is, in effect, spending the school trust's "capital" while somehow expecting the "interest" (timber yields) to remain constant. This makes no sense whatsoever.

Refer to the updated soils analysis for data on existing harvest impacts in the proposed project area. The analysis has been revised to report results of the aerial photo interpretation in addition to the field verification of the condition of the existing skid-trial system.

The DNRC is avoiding the entire issue of maintaining soil productivity. The Forest Service's Northern Region (FSM 2500-99-1) defines "Soil Function" thus:

> Primary soil functions are: (1) the sustenance of biological activity, diversity, and productivity, (2) soil hydrologic function, (3) filtering, buffering, immobilizing, and detoxifying organic and inorganic materials, and (4) storing and cycling nutrients and other materials.

Grier and others (1989), adopt as a measure of soil productivity: "the total amount of plant material produced by a forest per unit area per year." (P. 1.) And "Soil Quality" is

DNRC recognizes the potential negative effects of excessive soil displacement, compaction, and erosion. Moderate levels of ground disturbance of surface litter is desired to promote regeneration. Detrimental soil impacts are soil displacement (when duff and mineral soils are removed) and where that area combined with other impacts (erosion, compaction) exceeds 15 percent of the harvest unit.

defined as "The capacity of a specific soil to function within its surroundings, support plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation." (USFS Northern Region FSM 2500-99-1.)

Further, the scientific adequacy of the DNRC's methodology for maintaining soil productivity has never been demonstrated. This includes BMPS and all the mitigation measures proposed. They've never been validated as to protecting the productivity of the land. And BMP monitoring does not even attempt to measure post-project soil productivity, since the audits are not scientifically designed to do so.

The chemical and biological make-up of the specific soils in the project area, and their ability to withstand detrimental disturbance that lowers soil productivity is not a subject adequately taken up by the DEIS. Harvey et al., 1994 state:

> The ...descriptions of microbial structures and processes suggest that they are likely to provide highly critical conduits for the input and movement of materials within soil and between the soil and the plant. Nitrogen and carbon have been mentioned and are probably the most important. Although the movement and cycling of many others are mediated by microbes, sulfur phosphorus, and iron compounds are important examples.
>
> The relation between forest soil microbes and N is striking. Virtually all N in eastside forest ecosystems is biologically fixed by microbes... Most forests, particularly in the inland West, are likely to be limited at some time during their development by supplies of plant-available N. Thus, to manage forest growth, we must

Since 1998, DNRC has required timber-harvest projects to retain proportions of coarse woody debris and fine litter for nutrient cycling and wildlife needs. DNRC's goals for coarse-woody-debris levels are based on research by *Graham et al, 1994.*

Graham, Russell T.; Alan E. Harvey; Martin F. Jurgensen, Theresa B. Jain, Jonalea R. Tonn, and Deborah S. Page-Dumroese. 1994. Managing coarse woody debris in forests of the Rocky Mountains. Research Paper INT–RP-477. Moscow, ID: U.S. Department of Agriculture, Forest Service, Intermountain Research Station; 1994.

manage the microbes that add most of the N and that make N available for subsequent plant uptake. (Internal citations omitted.)

Adams and Froehlich (1981) provide reasons why impacts beyond directly compacted skid trails must be considered in any reasonable definition of soil productivity:

> Since tree roots extend not only in depth but also in area, the potential for growth impact also becomes greater as compaction affects more of the rooting area. In a thinned stand, for example, you can expect the greatest growth impacts in residual trees that closely border major skid trails or that have been subject to traffic on more than one side of the stem.

In other words, tree growth outside skid trails—beyond the compacted area—is detrimentally affected. This is ignored by the DNRC.

For a study done on the Kootenai and Flathead National Forests, soil scientists measured soil bulk densities, macropore porosities, and infiltration rates using paired observations of disturbed vs. undisturbed soils. They discovered that although "the most significant increase in compaction occurred at a depth of 4 inches… some sites showed that maximum compaction occurred at a depth of 8 inches… (and) Furthermore, ... subsurface compaction occurred in glacial deposits to a depth of at least 16 inches." (Kuennen, Edson, and Tolle, 1979.) The DNRC does not have enough soil bulk density and other compaction monitoring data collected at the adequate soil depths and in enough sites on the Stillwater State Forest to be able to make accurate predic-

DNRC recognizes the finding of the Kootenai study and extensive research related to soil impacts and design of mitigation measures intended to minimize excessive impacts and to verify the effects analysis. Previous studies have not quantified a direct effect based on distance to skid trails, but it is likely the trees near skid trails have a portion of their root systems that can be impacted and could result in reduced growth. Design of harvest plans and mitigation measures are intended to control the area of impacts to less than 15 percent of the area in detrimental soils through design of silvicultural treatments and skid-trail planning. Higher levels of soil impacts can occur if BMPs and mitigation measures are not implemented.

DNRC has completed postharvest soil monitoring on

tions about the effects of soil compaction.

Following another study carried out on the Kootenai NF and the Flathead NF, Cullen et al. (1991) concluded: "This result lends support to the general observation that most compaction occurs during the first and second passage of equipment." And Page-Dumroese (1993), in a research report investigating logging impacts on volcanic ash-influenced soil in the Idaho Panhandle NF, states, "Moderate compaction was achieved by driving a Grappler log carrier over the plots twice." Page-Dumroese (1993) also cited other studies that indicated: "Large increases in bulk density have been reported to a depth of about 5 cm with the first vehicle pass over the soil." Williamson and Neilsen (2000) assessed change in soil bulk density with number of passes and found 62% of the compaction to the surface 10cm to come with the first pass of a logging machine. In fine textured soils Brais and Camire (1997) demonstrated that the first pass creates 80 percent of the total disturbance to the site.

Adams and Froehlich (1981) state, "Unfortunately, little research has yet been done to compare the compaction and related

similar soils on Stillwater Unit. The results of this monitoring showed a range of soil impacts from 9 percent of the harvest area *(Lower Stillwater Timber Sale)* to 12.4 percent of the harvest area *(Chicken Werner* and *Ewing Extension timber sales)* when BMPs were implemented. DNRC has also completed soil monitoring State-wide to determine impacts of timber harvesting to many soil properties, including bulk density, displacement, and erosion. DNRC would implement BMPs and site-specific mitigation measures to minimize soil impacts on the proposed harvest project. DNRC has been, and continues to be, a lead agency at implementation of soil mitigation measures in timber sale contracts. These measures include, but are not limited to, the following: limits on season of operations to dry or winter conditions, slope restrictions on ground-based equipment, skid-trail planning to control the area of effect.

impacts caused by low-pressure and by conventional logging vehicles."

The Forest Service's Northern Region recognizes that soil quality standards must be validated. FSM 2500-99-1 recognizes that managers must:

Assess … whether (soil quality standards) are effective in maintaining or improving soil quality;

Evaluate the effectiveness of soil quality standards and recommend adjustments …

Consult with soil scientists to evaluate the need to adjust management practices or apply rehabilitation measures.

Page-Dumroese et al. (2000) emphasize the importance of validating soil quality standards using the results of monitoring:

> Research information from short- or long-term research studies supporting the applicability of disturbance criteria is often lacking, or is available from a limited number of sites which have relative narrow climatic and soil ranges. …Application of selected USDA Forest Service standards indicate that blanket threshold variables applied over disparate soils do not adequately account for nutrient distribution within the profile or forest floor depth. These types of guidelines should be continually refined to reflect pre-disturbance conditions and site-specific information. (Abstract.)

The DEIS relies upon mitigation measures and vague soil restoration measures, yet fails to disclose the reliability of those measures for actually protecting soil productivity and water quality.

Grier et al. (1989), cite a study finding "a 43-percent reduction in seedling height growth in the Pacific Northwest on primary skid trails relative to uncompacted areas" for example. And in another report, Adams and Froehlich (1981) state:

Resource professionals evaluate through timber sale administration and on-site reviews the reliability of mitigation measures to protect soil productivity. In addition, past and ongoing soil monitoring efforts by DNRC evaluate the reliability of soil mitigation measures. Data on effectiveness of BMPs State-wide may be found in the *Forestry BMP Audit Report (DNRC, 1990, 1992, 1994, 1996, 1998, 2000, 2002, 2004).*

Measurements of reduced tree and seedling growth on compacted soils show that significant impacts can and do occur. Seedling height growth has been most often studied, with reported growth reductions on compacted soils from throughout the U.S. ranging from about 5 to 50 per cent.

Alexander and Poff (1985) reviewed literature and found that as much as 10% to 40% of a logged area can be disturbed by skyline logging. They state:
There are many more data on ground disturbance in logging, but these are enough to indicate the wide diversity of results obtained with different equipment operators, and logging techniques in timber stands of different composition in different types of terrain with different soils. Added to all these variables are different methods of investigating and reporting disturbance.

In sum, the DEIS does not rely upon scientifically credible data or analysis, yet proposes more soil disturbance, resulting in unknown reductions in soil productivity.

According to *ARM 36.11.420 (1)*, "The department shall design all prescribed silvicultural treatments to maintain the long-term productivity of the site in order to ensure the long-term capability to produce trust revenue." DNRC reviews soils data and past effects to design mitigation measures to limit the area and degree of soil impacts and promote healthy forests. DNRC reviews ongoing harvesting activities to ensure implementation of mitigation measures and continues to monitor soil effects on a portion of completed timber harvest projects. Soils evaluations begin with review of mapped soil types. Through on-site field reviews, resource professionals then consider site variables, limitations, and appropriate mitigation measures. Expected effects are then compared with monitoring and research to ensure protection of soil productivity.

A big problem is the DNRC's failure to deal forthrightly with the noxious weed problem. The long-term costs are never adequately disclosed or analyzed. The school trust is expected to continuously foot the bill for noxious weed treat-

DNRC shares the concern of noxious-weed infestations and control of those infestations with county weed districts and the public. Weeds are limited to spot infestations in the project area. Means to mitigate or minimize the chances of noxious weeks becoming established on the proposed timber sale project area

ments—the need for which increases yearly as the DNRC continues the large-scale propagation of weeds, and fails to monitor the effectiveness of its noxious weed treatments.

are described in *APPENDIX A - STIPULATIONS AND SPECIFICATIONS, page A-5,* and *ARM 36.11.445.*

DNRC's noxious-weed program categorizes species with various goals and methods for control consistent with the County Weed District agreement. Stillwater Unit's noxious week coordinator monitors the noxious weed situation, especially new invader species, in order to prioritize and implement control measures.

A component of the DEIS that is noticeably missing is a cumulative impacts analysis for all of the above resource concerns. This timber sale is not occurring in an area without past impacts from logging and road building. MEPA requires an evaluation of cumulative (defined as: the collective impacts on the human environment of the proposed action when considered in conjunction with other past and present actions related to the proposed action by location or generic type) and secondary (defined as: a further impact to the human environment that may be stimulated or induced by or otherwise result from a direct impact of the action) impacts on the physical environment. Such analyses are extremely inadequate in this DEIS.

The cumulative impacts of logging and road building in the analysis area were adequately considered and discussed in several places in the *DEIS,* including *APPENDIX B - VEGETATION ANALYSIS; APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS; APPENDIX D - SOILS ANALYSIS; APPENDIX E - FISHERIES ANALYSIS; APPENDIX F - WILDLIFE ANALYSIS;* and *APPENDIX G - ECONOMIC ANALYSIS.* Cumulative impacts were addressed in a manner appropriate for the scope and issues developed in the *DEIS.*

The economics analysis is completely inadequate. There is no itemized disclosure of costs vs. benefits, nor discussion.. In other words, you should give consideration to, and adequately document, who benefits by these projects and who "pays" for them. We ask that all costs and benefits be itemized in the analysis, so the pubic can see these figures.

An analysis is made of relevant "local" costs in the *DEIS (APPENDIX G - ECONOMIC ANALYSIS, pages G-3* through *G-8).* This analysis is directed primarily to look quantitatively at estimated direct impacts of the sale on the trusts and, to a lesser extent, on the local community. Some cost and benefits, particularly when they relate to indirect issues, are dealt with qualitatively *(DEIS, APPENDIX G - ECONOMICS ANALYSIS, pages G-6* and *G-7).* In a recent State court ruling, Judge Sherlock, in his Order Granting Summary Judgment *(#BDV-2003-527),* determined that DNRC did not have an obligation to do individual sale accounting. Consequently, the analysis of the estimated revenues and costs from the sale are based on broad averages in order to ensure that, on average, DNRC can expect to

Net public benefit is determined by numerous inputs and outputs, some of which are quantifiable and others which are more qualitative. Economic analysis can provide a useful basis for evaluation only if the economic evaluation is

comprehensive and documents all costs and benefits related to the proposed action. We would like the analysis to:
(1) Insure that the economic analyses are meaningful, by including in the analyses both direct and induced costs;
(2) Adequately assess all current, in-place benefits;
(3) Include impacts to hunter opportunity and other forms of recreation (how will the proposed project impact the quality of backcountry hiking, for example?);
(4) Quantify all induced losses to outfitters and guides who may currently derive economic benefits from the areas;
(5) Consider all costs related to the projects, including the costs of preparing the analyses, all specialist support and consultation, costs associated with travel management and administration, road construction and engineering expenses, weed control, reforestation and planting, stand exams, timber stand improvement, and all other costs.

It is our intention that you include in the record and review all of the literature and other incorporated documents we've

show a net benefit to the trusts from its sale activities. Induced or secondary effects are based on the estimates derived from averages. No attempt is made to do the individual sale accounting as suggested by the comments.

Based on the above discussion and the DEIS documents, where it is relevant:

1) The economic analysis is meaningful and the analysis includes a direct-effects analysis as well as an indirect-effects analysis *(DEIS, APPENDIX G - ECONOMICS ANALYSIS, page G-3, TABLE G-3 - ESTIMATED REVENUES AND EXPENDITURES FROM THE WEST FORK OF SWIFT CREEK TIMBER SALE PROJECT; and page G-4, TABLE G-4 - NUMBER OF STUDENT SUPPORTED BY 1 YEAR OF ESTIMATED REVENUE)*.

2) The analysis assesses all relevant current 'in-place' benefits.

3) Recreational benefits and costs, including those associated with hunting, are discussed *(DEIS, APPENDIX G - ECONOMICS ANALYSIS, page G-6, Nonmarket Issues)*.

4) All costs needed to do the required analysis are considered (DEIS, APPENDIX G - ECONOMICS ANALYSIS, page G-3, TABLE G-3 - ESTIMATED REVENUES AND EXPENDITURES FROM THE WEST FORK OF SWIFT CREEK TIMBER *SALE PROJECT)*.

The purpose of DNRC timber sales is to provide revenue to the trust, and, as a means of accomplishing this objective, to maintain forest health and biodiversity. This is the premise of the Omega Alternative identified in the *State Forest Land Management Plan*, and it is at this programmatic level that the broader net benefits of the program are analyzed. As a result, the DEIS analysis focuses on the net benefits to the trust, forest health, and biodiveristy and considers other net benefits as external to the primary requirements of the DEIS.

DNRC acknowledges the reference listing forwarded to us; your use makes them part of the record.

cited herein. Please contact us if you have problems locating copies of any of them. Thank you for your attention to these concerns. Please keep each organization on your list to receive further mailings on the proposal.

We conclude this comment letter with this passage from Frissell and Bayles (1996):

> Most philosophies and approaches for ecosystem management put forward to date are limited (perhaps doomed) by a failure to acknowledge and rationally address the overriding problems of uncertainty and ignorance about the mechanisms by which complex ecosystems respond to human actions. They lack humility and historical perspective about science and about our past failures in management. They still implicitly subscribe to the scientifically discredited illusion that humans are fully in control of an ecosystemic machine and can foresee and manipulate all the possible consequences of particular actions while deliberately altering the ecosystem to produce only predictable, optimized and socially desirable outputs. Moreover, despite our well-demonstrated inability to prescribe and forge institutional arrangements capable of successfully implementing the principles and practice of integrated ecosystem management over a sustained time frame an at sufficiently large spatial scales, would-be ecosystem managers have neglected to acknowledge and critically analyze past institutional and policy failures. They say we need ecosystem management because public opinion has changed, neglecting the obvious

point that public opinion has been shaped by the glowing promises of past managers and by their clear and spectacular failure to deliver on such promises.

Sincerely,

/s/

Jeff Juel

And on behalf of:
Michael Garrity
Alliance for the Wild Rockies
P.O. Box 505
Helena, Montana 59624
406-459-5936

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Jane Adams
Montana Old Growth Project
1401 4th Avenue West
Kalispell, Montana 59901

RECEIVED
NOV 24 2004

Mike McMahon
Stillwater State Forest
P.O. Box 164
Olney, Montana 59927

Dear Mike, November 20, 2004

Please accept these comments on the West Fork of Swift Creek Timber Sale DEIS.

The Montana Old Growth Project prefers alternative A or C, neither of which propose to harvest in old growth forest. We are strongly opposed to alternative B, which would harvest 286 acres of old growth by regeneration harvest method. The DEIS states that the harvest in area III (where the old growth is) would be so intense as to simulate a stand-replacing fire.

As your DEIS states, currently only 8,693 acres, or 8.7% on the Stillwater are currently old growth. Along with the harvest of old growth in nearby recent past and future sales, choosing alternative B would reduce the old growth on the Stillwater down to 8.2% of the forest. The DEIS neglected to report on historical estimates of old growth on the Stillwater State Forest or in climatic section M333C, information which should be included in the FEIS for the public and the decision maker to consider. Historical estimates of old stands in Climatic Section M333C average 29% for all cover types (Losensky 1997). DNRC's estimate of the amount of old growth historically existing on the Stillwater State Forest is 32% (DNRC 2000). Contrary to statements made in the DEIS, harvesting this old growth WILL NOT move conditions towards historical conditions, but further away.

The DEIS states that this timber sale was prepared under the philosophy of the State Forest Land Management Plan (SFLMP) and the guidance of the recently adopted Administrative Rules. While the numerical old growth commitment of the SFLMP is not within the rules, both the SFLMP and the rules are clear on the basic philosophy regarding maintenance of biodiversity and emulating historical conditions. Several sections in the administrative rules address old growth and historical conditions:

IV- BIODIVERSITY - COARSE FILTER APPROACH " *The department shall promote biodiversity by taking a coarse filter approach thereby favoring an appropriate mix of stand structures and compositions on state lands*". The definition for coarse filter states "*A coarse filter approach assumes that if landscape patterns and process similar to those species evolved with are maintained, then the full complement of species will persist and biodiversity will be maintained*".

Your comments appear to be concerned with age classes of timber stands, particularly the older age class. Age-class distribution is discussed in the *DEIS, CHAPTER III, pages III-4, III-7,* and *III-8, APPENDIX B - VEGETATION ANALYSIS, pages B-4* and *B-9 through B-11.* However, some confusion regarding the terms "old stands" and "old growth" is evident in the comments and should be clarified.

In his compilation of an inventory conducted in the 1930s, *Lozensky* shows that 29 percent of the area within the M333C Climatic Section was classified as "old stands" (meaning they were older than 150 years and contained a minimum of 4 mbf per acre). In 2000, using the best available data, DNRC estimated that, on average, 32 percent of Stillwater Unit would have been in "old stands". At the time, DNRC used the definition for "old stands" from the *Lozensky* work as a surrogate for "old growth" because no estimates for naturally occurring amounts of "old growth" were available. Thirty-two percent of Stillwater Unit would have historically met DNRC's then-current definition of "old growth", which were "stands with a substantial overstory component of trees 150 years old and older and with a minimum of 4 mbf per acre". Lodgepole pine stands were only required to be 140 years old to meet the definition.

In 2003, 48 percent of the area on Stillwater Unit was in the older age class (*DEIS, APPENDIX B - VEGETATION ANALYSIS, page B-4*). This, too, is an estimate of "old stands" and not "old growth". The estimate is directly comparable to the 29 and 32 percent of "old stands" discussed in the preceding paragraph whereas the amount of "old growth" described in the DEIS is not directly comparable due to the different definitions.

DNRC's definition of old growth is now based upon *Green et al.*, and there is no direct link to estimating naturally occurring old-growth amounts based on the current definition. DNRC's current old-growth definitions are described in *ARM 36.11.403.48.*

VII - BIODIVERSITY - MANAGEMENT ON BLOCKED LANDS: *"Within areas of large blocked ownership, the department shall manage for a desired future condition that can be characterized by the proportion and distribution of forest types and structures historically present on the landscape".*

XVIII - BIODIVERSITY - OLD GROWTH MANAGEMENT *"Stand age distributions, including old growth, shall be evaluated and managed as described in New Rules VII and XVI based on the patterns historically present on the landscape as a result of natural disturbances.*

It appears to me that there is no justification for harvesting old growth on the Stillwater when the current amount of old growth is only about one-fourth of the historical amount. Given the philosophy and guidance of the SFLMP and rules to manage for a desired future condition based on historic structures and forest types, and to promote biodiversity by managing for the conditions that species evolved with, any further unnecessary reduction of old growth is unjustified. Especially given the large and disproportionate contribution that old growth makes to the maintenance of biodiversity. Harvesting old growth will only move conditions further away from historic conditions, and from conditions that species evolved with.

In addition to the acreage of old growth that would be harvested, the type of harvest proposed would create discrete edges between harvested and unharvested areas. I see that the wildlife analysis does mention the edge effect under the coarse filter analysis, and does a quantitative assessment of the change in edge versus interior forest. However, lacking is any comparison to historic conditions or description of the negative impacts of edge habitats. The analysis merely states "Habitat for species that use forested and interior habitat would decrease, while species that use edge habitat and regeneration or unforested habitats would be favored". This statement is essentially useless to the decision maker or the general public, giving no frame of reference or information on which to judge whether conditions are moving towards or away from historic conditions, or whether this is better or worse for wildlife.

Two MSU professors, Kerrie Forseman and Colin Henderson, while under contract with DNRC, found that problems with the old growth situation on the Swan River state forest were not so much with the total amount of forest, but with fragmentation. Compared with historic conditions, current conditions are highly fragmented, having higher edge to interior ratios, smaller patch size, and reduced connectivity (DNRC 1997). Forest fragmentation is generally ubiquitous in managed landscapes and a big problem for many wildlife species, particularly those species that are rare and/or whose conservation is a concern (Noss 1996). Species that do well in edge habitats, such as cowbirds, American robins and white-tailed deer, are generally widespread and are of little conservation concern. Negative impacts due to the "edge effect" have been documented for many species, and include increased exposure to predators, increased penetration by noxious weeds, and increased exposure to wind and temperature extremes. All of these may impact the ability of old growth dependant plants and animals to survive and successfully reproduce. The DEIS states that the adjacent harvested areas may act as a fire-break. While this may be true sometimes, it is also true that the openings will allow the drying effects of wind and sun to penetrate into the forest, making it less resistant to fire.

Please keep me informed of all developments regarding this timber sale, and particularly let me know if there are any opportunities to view the stands in Area III. Thank you for considering my comments.

Sincerely,

Jane Adams

Jane Adams

Citations

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OWENS & HURST LUMBER CO., INC.

November 10, 2004

RECEIVED
NOV 15 2004

Mike McMahon, Project Leader
Stillwater State Forest
P.O. Box 164
Olney, MT 59927

Re: West Fork Timber Sale Project

Dear Mike:

Owens & Hurst Lumber Company, Inc., supports your Action Alternative B for the above designated Timber Sale Project. We agree with your reasoning that harvest activities in old growth stands would take on the role of a stand-replacing fire in old growth. It has been reported by some scientists that old growth stands do need management to maintain those attributes we identify with old growth. We also know that with no management, old growth stands will be destroyed, usually through a stand-replacing fire event.

The long term benefits far outweigh any short term adverse effect on grizzly bear habitat. It has been reported by Canadian researchers that the grizzly bear prefers larger disturbed areas. This increases forage area but does decrease hiding cover. However, hiding cover is not a limiting factor for the bear.

Commercial thinning utilizing a skyline cable system is not impossible but is expensive. Forwarder logging has been used in some skyline cable units. Would that be a possibility in this project area?

Thank you for the opportunity to comment.

Keith Glover
Resource Manager

KG/rw

P.O. BOX 1316 EUREKA, MONTANA 59917 TELEPHONE 406-297-3114 FAX 406-296-2334

Ground-based forwarding operations may take place in some locations, but a substantial amount of steep topography would still require skyline cable operations.

Thank you for your interest in the project.

APPENDIX I
PEOPLE CONTACTED

Jane Adams
Alliance for the Wild Rockies
Frances Anderson
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ACRONYMS

ARM	Administrative Rules of Montana
BMP	Best Management Practices
cmp	corrugated metal pipe
CS	Common Schools (trust)
dbh	diameter at breast height
DEQ	Department of Environmental Quality
DFWP	Department of Fish, Wildlife and Parks
DNRC	Department of Natural Resources and Conservation
DEIS	Draft Environmental Impact Statement
EA	Environmental Assessment
ECA	Equivalent Clearcut Acres
EIS	Environmental Impact Statement
EPA	Environmental Protection Act
FEIS	Final Environmental Impact Statement
FI	Forest Improvement
FNF	Flathead National Forest
IGBC	Interagency Grizzly Bear Committee
mbf	thousand board feet
MCA	Montana Codes Annotated
MEPA	Montana Environmental Protection Agency
mmbf	million board feet
MNHP	Montana Natural Heritage Program
NCDE	Northern Continental Divide Ecosystem
NWLO	Northwestern Land Office
RMZ	Riparian Management Zone
SFLMP	State Forest Land Management Plan
SLI	Stand Level Inventory
SMZ	Streamside Management Zone
TLMS	Trust Land Management System
TMDL	Total Maximum Daily Load
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service

ID Team	Interdisciplinary Team
Land Board	Montana Board of Land Commissioners
124 Permit	Stream protection Act Permit
3A Permit	Authorization A – Short-term Exemption from Montana's Surface Water-Quality Standards
SFLM Rules	State Forest Land Management Rules

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